US Army Corps
of Engineers
Tulsa District

LAKE WICHITA

HOLLIDAY CREEK, TEXAS

HOLLIDAY CREEK, WICHITA FALLS, TEXAS
LOCAL FLOOD PROTECTION

SPILLWAY FOUNDATION REPORT

DECEMBER 1997

Holliday Creek, Wichita Falls, Texas
Local Flood Protection Spillway Foundation Report

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LAKE WICHITA
HOLLIDAY CREEK, WICHITA FALLS, TEXAS
LOCAL FLOOD PROTECTION

SPILLWAY FOUNDATION REPORT

U.S. ARMY ENGINEER DISTRICT, TULSA
CORPS OF ENGINEERS
TULSA, OKLAHOMA

LAKE WICHITA
HOLLIDAY CREEK, TEXAS

SPILLWAY FOUNDATION REPORT

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LAKE WICHITA
HOLLIDAY CREEK, TEXAS

SPILLWAY FOUNDATION REPORT

I - INTRODUCTION

1-01. Purpose and Scope. This report presents pertinent information gathered and conditions encountered during the foundation excavation for the primary spillway at Lake Wichita dam. Included in the report is a description of the geology, excavation procedures, character of the foundation, foundation preparation, special treatments, logs, plates, and photographs.

1-02. Project Authorization. Public Law 99-662 authorized the Lake Wichita, Holliday Creek, local protection project in November, 1986. The city of Wichita Falls has signed a Local Cooperation Agreement, which contains specific costsharing guidelines conforming to PL 99-662. This project includes the rehabilitation of the Lake Wichita dam.

1-03. Location and Description. Lake Wichita is located on Holliday Creek about six miles southwest of the center of the business district of Wichita Falls, Texas. Holliday Creek, rises in Archer County and flows northeasterly to its confluence with the Big Wichita River in the city of Wichita Falls. At normal pool, Lake Wichita covers about 2 square miles, with a volume of about 5,570 acre-feet. The Holliday Creek watershed is about 32 miles long, has a maximum width of 9 miles, and a drainage area of about 154 square miles. About 128 square miles of this drainage is located above the Lake Wichita damsite. Prior to the reconstruction, Lake Wichita dam consisted of a low earthfill structure 6,250 feet long with a maximum height of approximately 28 feet. The embankment, with a top elevation varying between 983 and 990, had a 20-foot-wide crest, with a timber retaining wall, 1,950 feet long, which was used to protect part of the upstream slope from erosion. The initial embankment was built in 1901 and later modified in the 1970's. A 400-foot-wide uncontrolled concrete ogee weir spillway with crest elevation at 980.44 was located in the right abutment, 290 feet downstream of the box culvert bridge on Old Lake Road (FM 2380). The outlet works consisted of two 36-inch-diameter cast iron pipes through the embankment that connected into a concrete vault located on the downstream side of the dam in the Holliday Creek valley. The vault housed the control valves for the outlet works. West of the outlet works, an irrigation and surface drainage ditch ran along the downstream toe of the dam for approximately 1900 feet.

1-04. **Description of Work Done Under this Contract**. This contract modifies the existing dam to include a main embankment, a series of dikes, two spillways, and an outlet works. The main embankment and the series of dikes are rolled earthfills having crest widths of 16 feet at elevation 993.0 NGVD. The embankment incorporated the existing dam by plating the downstream or upstream face and raising the top of the dam. The outlet works is a concrete sluice structure located at station 71+82.05 of the main embankment. It consists of an intake structure with manually operated gates, and a stilling basin with outfall invert elevation at 966.0. The primary spillway consists of a 200-foot-wide concrete uncontrolled rectangular broadcrested weir with a crest elevation of 976.0 (see photos 1 and 2). The centerline of the primary spillway is at embankment station 64+52.25. A 200-foot-wide rectangular concrete chute on 1V to 3H slope connects the weir to a concrete stilling basin. The auxiliary spillway consists of a 400-foot-wide concrete uncontrolled trapezoidal broadcrested weir with a crest elevation of 982.0. The auxiliary spillway is located between the auxiliary dike and dike No. 2, and 270 feet upstream of the box culvert bridge on FM 2380.

1-05. **Contractor and Corps of Engineers Supervision**. The project was designed by Fort Worth District, constructed by Min-Kota of Brooklyn Park, Minnesota, and administered by the Tulsa District.

Contractor Supervision and Quality Control

Contractor:	Min-Kota
Address:	3401 85th Avenue North Brooklyn Park, MN 55443
Project Superintendent:	Dale Moser
Project Engineer:	Kym Burgstrom
Project Quality Control:	Mike Henly
Project Surveyor:	Subcontractor: Biggs & Mathews

Corps of Engineers Supervision

Resident Engineer:	Dennis Frazier
Office Engineer:	Gerald Grosz
Geologist:	David Struck
Chief, Laboratory:	Doug Booth

II - GEOLOGY

2-01. Physiography. The project is in the Red River rolling plains of North Central Texas. The region is generally characterized as a rolling plain with some broken terrain and low hills. Local relief is measured in tens of feet. Soil cover is generally thin, and supports a growth of mesquite brush and native grasses. Local rock outcrops consist primarily of shales and sandstones, with some limestones.

2-02. Regional Geology. The Lake Wichita region is in the Osage Plains subsection of the Central Lowlands physiographic province. Stratigraphically, the region is underlain by geologic strata belonging to, in ascending order, the Putnam Formation, the Admiral Formation, and the Belle Plains Formation. These formations are generally considered part of the upper Wichita Group of mid-Permian (Leonard) age. In this part of north-central Texas, the upper Wichita Group consists of shales with interbedded sandstone. These beds transition laterally southward into the limestone and shale deposits of Central Texas. The limestones have a marine origin, but change northward to rock from shallow water continental deposits, typically represented by the 20-foot-thick sandstone encountered at Lake Wichita. This sandstone has not been named, but it occurs approximately 50 feet lower in the section than the Elm Creek Limestone member of the Admiral Formation. Structurally, major sedimentary basins to the southwest account for the lateral change to marine limestone in Central Texas. The Anadarko Basin in Oklahoma and the Llano Uplift to the southeast, with influence by local structures (such as the Red River Uplift and the Fort Worth Basin), control the attitude of Wichita strata in this region. The regional dip is less than one degree to the west-northwest and is reflected in the local strata.

2-03. Geology of the Dam Site. The project is located in the Wichita group, Wolfcamp Series, Permian System of the Paleozoic Era. In Design Memorandum No. 2, prior to 1987, the surface formation was called the Admiral Formation. However, there exists a facies change in the formation at this site and the rock encountered is not the same as what is represented in the geological description for the type locality assumed for this region. Therefore, in the revised Texas Geological Atlas, a decision was made to change the nomenclature, redividing some formations. North of the Brazos River (approximate boundary) the formation is called the Nocona Formation. The Nocona Formation is equivalent to the Admiral Formation and the upper Coleman Junction Formation. The Nocona Formation is composed of mudstone, sandstone, siltstone and conglomerate, reddish-brown mudstone predominates. The following two excerpts from the new Geologic Atlas describe the formations in the damsite area. The atlas indicates that the Petrolia Formation is the surface formation at the damsite (see exhibit 1, Geologic Atlas of Texas, Wichita Falls-Lawton Sheet (in part), revised 1987).

Petrolia Formation. *The Petrolia corresponds with two formations, Jagger Bend and Valera Formation, undivided (Pjv) and Elm Creek (Pec). The Petrolia Formation (new), Pp, with sandstones, ss10, ss9, ss8, ss7, ss6, ss5, ss4, ss3, ss1, separately mapped. Stratigraphic cutoff of Pjv and Pec is at Brazos River. Mudstone, shale, sandstone, conglomerate, and limestone; mostly reddish-brown mudstone, unstratified and crudely stratified calcareous nodules common, laminated and cross bedded sandstones in lentils and small channel-fill bodies throughout containing plant fossils and rare vertebrate footprints, gray and variegated planar and Plano convex lenses of claystone and shale like those of the Waggoner Ranch Formation common in Baylor and Archer Counties; lenticular, calcareous-nodule conglomerates throughout, poorly indurated, locally contain abundant vertebrate fossils; limestone (northward extension of basal beds of Elm Creek Formation), light-gray, very argillaceous, locally desiccation-cracked, thin-bedded, discontinuous, locally very sandy, northern termination of basal Elm Creek Limestone bed near Lake Kickapoo. Sandstones, brown and reddish-brown, fine to medium-grained, thick-bedded to massive, crossbedded, commonly soft-sediment-deformed, locally conglomeratic with clasts of mudstone and calcareous nodules, sandstone bodies discontinuous, restricted to northern portions of outcrop belt, generally deeply weathered and poorly exposed across gently rolling terrain, locally folded northeast of Wichita Falls; thickness of sandstone members 3 to 25 feet. Thickness of Petrolia (new) 360 to 400 feet.*

Nocona Formation. *The Nocona corresponds with Admiral Formation (Pad) and the Coleman Junction Formation (Pcj). The Nocona Formation (new), PN, with sandstones, ss11, ss10, ss9, ss8, ss7, ss6, ss5, ss4, abd ss1, separately mapped. Stratigraphic cutoff of Pad is in southwestern Archer County. Mudstone, sandstone, siltstone, and conglomerate; reddish-brown mudstone predominates, locally gray and variegated in thin beds and planoconvex lenses in part containing vertebrate and abundant plant fossils, crudely stratified and unstratified calcareous nodules common, laminated and cross-laminated sandstones and siltstone in thin sheets and lentils 1 to 3 feet thick throughout, lenticular calcareous-nodule conglomerate common. Sandstones, ss11, ss10, ss9, ss8, ss7, ss6, ss5, ss4, abd ss1, tan to dark-brown, fine-grained to very coarse grained, locally conglomeratic (chert clasts) in easternmost part of outcrop belts, in part massive, thin- to thick-bedded, soft-sediment deformation typical in thicker beds, large-scale crossbeds common, sandstone beds generally thinner and increasingly less numerous southwestward; in Clay County, individual members locally exhibit multistory configuration of sandstone beds; thickness of sandstone members 5 to 40 feet. Thickness of Nocona Formation (new) 280 to 350 feet; Pn thickens northeastward.*

a. Observations at the Site. In places, the sandstone appears to be crossbedded while in other locations the bedding is more horizontal and contains poorly preserved plant fossils. Joints within the crossbedded area are filled with a yellow leather-like substance. An extensive survey was not made of the base of the sandstone to determine

general dip, however some point measurements were taken. Nodules which appear to be iron concretions are scattered throughout the excavation site, with the largest concentration located about two-thirds the way up on the right bank. Some of the more weathered nodules display greens and blues indicating the presence of copper. The green is also disseminated in the clay shale on the left side of the spillway.

Slickensiding (not due to equipment) was observed in the shale. The clay shale also exhibited jointing with no discernible bed displacement, possibly being ancient desiccation cracks. There appears to be a displacement in the base of the sandstone on the right side of the spillway excavation at station 413+30 and also on the left side of the excavation at station 415+56. There were wet spots near each of these displacements. The upstream wet spot is located on the left side of the spillway (northwest), approximate station 415+46, 130 feet left of the spillway centerline. The spot is about 5 feet above the floor excavation and is moist around several cracks and appeared to flow where they coalesced (see photos 3 through 5). This was a minor problem during construction as the weather was dry. The upstream wet spot is about 200-250 feet from the lake and below the lake level. The downstream wet spot was located on the right side of the spillway, approximate station 413+30, 100 feet right of centerline, and had a pump in it most of the time. This wet spot seems to be where the sandstone butts up against a dark shale. The sandstone may be a stream channel deposit and the wet spot may be from a pond just uphill and off the property, (see photos 6 through 8).

b. Seismicity. Lake Wichita Dam is located within Zone 1 on the Uniform Building Code (UBC) Seismic Risk Map of the United States, indicating that minor damage to structures could occur in the event of earthquake activity. The following parameters were used for the design of an earthquake event:

Frequency of occurrence	2,000 years
Magnitude (M)	4.6
Horizontal Acceleration	0.032 g
Horizontal Velocity	1.0 cm/sec

III - FOUNDATION EXPLORATION

3-01. Investigations Prior to Construction. Site investigations were conducted at Lake Wichita Dam by both Tulsa and Fort Worth Districts, U.S. Army Corps of Engineers. Results of site investigations conducted by Tulsa District were presented in General Design Memorandum No. 1, published in June 1985. Additional investigations were

conducted by Fort Worth District in 1988. Locations of borings are shown on plate 9. Geologic logs of borings are shown on plates 12 through 18.

a. Investigations by Tulsa District. Investigations by Tulsa District included a total of 20 borings, 4 of which had been drilled in 1959 for the Site Survey Report. Overburden was sampled with continuous 6-inch Denison barrels, and 4-inch core samples were taken of the underlying rock. Bail tests and/or pressure tests were used to establish field permeability values.

b. Investigations by Fort Worth District. Additional investigations were performed by the Fort Worth District in preparation of the Feature Design Memorandum which included 14 additional borings. Six borings were drilled to investigate conditions at the embankment and spillway sites, and eight borings were drilled along the proposed realignment of the Holiday Creek channel. Overburden was sampled with a 6-inch Denison sampler, 12-inch flight auger, and a 4-inch hand auger. Six-inch cores were taken in bedrock material. Field permeability was evaluated in selected borings using bail/recovery and pressure tests.

3-02. Investigations During Construction. Daily inspections by field personnel were performed to assure quality control. Every ten square feet or lesser area of the spillway foundation was mapped (see plate 5) and photographed (see example photos 10-13) at the time of foundation approval. The full inventory of photographs is currently retained at the field project office.

IV - EXCAVATION

4-01. Spillway Overburden Excavation. Overburden was excavated using dozers with rippers, and tracked backhoe or tractor-mounted backhoe loading into scrapers.

4-02. Spillway Rock Excavation. Rock was excavated using dozers with rippers and tracked backhoe or tractor-mounted backhoe loading into scrapers. Blasting was not required for removal of the materials. Due to the exposed shales being subject to possible slaking as a result of moisture loss, removal of the inplace material was halted a minimum of two feet above final grade. The final excavation was then made using a trackhoe to remove the bulk of the material, followed by hand cleanup and application of a sealer in designated areas to prevent moisture loss.

4-03. Spillway Foundation Preparation. Excavation to final grade proceeded in patchwork fashion, generally 10-foot by 10-foot areas. The area was cleaned, mapped, and photographed. Exposed rock under or within 5 feet of the planned concrete

portions of the spillway structure received a protective resin sealer within 60 minutes of being exposed. Within 24 hours, these areas were then covered with 3½ inches of protective concrete, 12 inches of filter sand covered with 3½ inches of protective concrete, or compacted fill, depending on which of the three coverings the plans indicated. Areas outside the sealed footprint received compacted fill.

V - CHARACTER OF FOUNDATION

5-01. General. The foundation of the spillway from approximate station 413+00 to station 415+74 is mudstone (clay shale) moderately soft, blocky and slickensided, mostly dark gray, but with some red shale, approximately 24.5 feet thick (see photo 10). The foundation from station 415+74 to station 415+88 along the centerline and up the incline is sandstone, vertical distance 4.667 feet. The foundation from station 415+88 to station 416+03 is primarily siltstone. The balance of material along the centerline is interbedded sandstones and shale. See photos 10 through 13.

5-02. Foundation Anchors. There are 84 #9 rebar foundation anchors in the spillway. There are 36 anchors, grouped 12 across in 3 rows, located in the stilling basin, one row of 12 anchors about midway in the incline chute, and 3 rows of 12 anchors at the bottom portion of the incline. The anchors are 8 feet apart, center-to-center, transverse to the centerline, and 9 feet apart parallel to the centerline within the appropriate groupings. Six-inch-diameter holes were drilled 15 feet into the foundation at approximate right (90°) angles to the protective concrete covering. Only the 36 anchors in the stilling basin are vertical. The anchors were grouted using a nonshrink Portland cement grout. Two anchor pull-out tests were performed in accordance with the specifications and the results met all requirements. See photos 14 through 18.

5-03. Protective Concrete. A 3½-inch layer of protective concrete covered the area under the concrete spillway, spillway wall foundation, and the area five feet outside of the spillway wall foundation. The protective concrete covers the sealed foundation, shale or sandstone, or 12 inches of filter sand as indicated in the plans.

5-04. Filter Sand. Twelve inches of filter sand provide drainage under the concrete apron portion of the spillway. The water is collected by drain pipes that connect to the drainage system along the walls of the spillway. A modification to the filter gradation was granted during construction to allow the percentage of material passing the No. 100 seive size to change from the maximum specified 3 percent to 5 percent because the selected source was unable to produce the gradation. The filter gradation conformed to the following specified limits.

FILTER MATERIAL GRADATION

Seive Size (square mesh)	*Percent Passing (by weight)*
3/8-inch	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	20-60
No. 50	10-30
No. 100	0-5*

* Modified during construction from 0-3 to 0-5 percent.

5-05. Dewatering. The only dewatering done was with sump pumps which were used to control the ponded water from the low areas in the spillway excavation.

5-06. Foundation Grouting. Pressure testing conducted indicated through seepage would be negligible, consequently no foundation grouting was done.

VI - CONCLUSIONS

6-01. Conclusions.

a. The sandstone and shales comprising the foundation of the spillway are considered adequate.

b. The foundation is considered to be tight, however, the origin of the groundwater producing the two wet spots was not determined.

c. Instrumentation in the spillway was not considered necessary.

e. The UBC seismic area is zone 1.

VII - REFERENCES

The following listed references were used in preparation of this report.

1. Geologic Atlas of Texas, Wichita Falls-Lawton Sheet, revised 1987
2. Design Memorandum No. 2, Embankment, Spillway and Outlet Works, March 1989
3. Project Plans and Specifications
4. Geology of Texas, vol. 1, Stratigraphy 1932, ninth printing 1990

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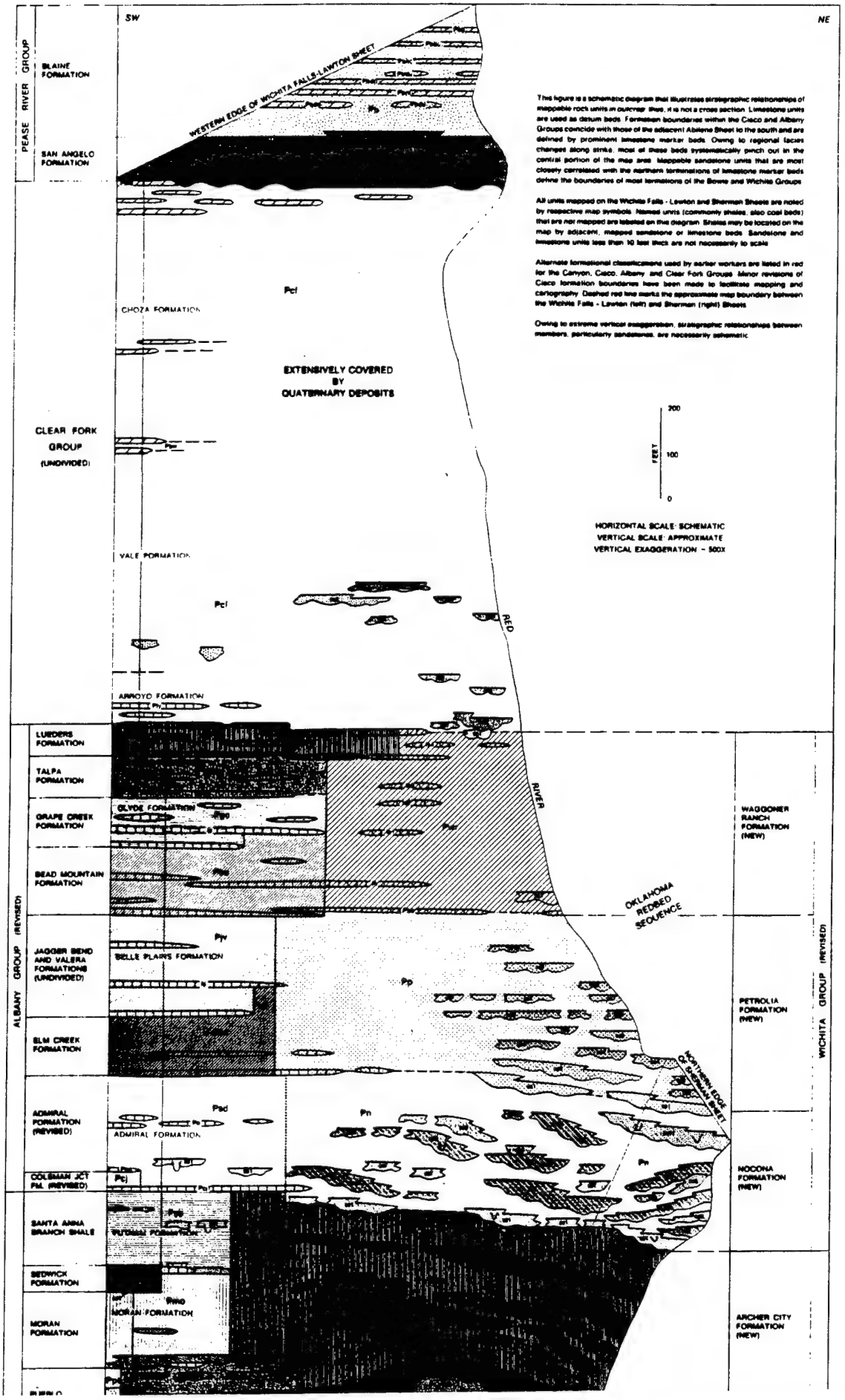
GEOLOGIC ATLAS OF TEXAS

WICHITA FALLS - LAWTON SHEET

(IN PART)

EXHIBIT 1

PENNSYLVANIAN AND PERMIAN ROCKS, WICHITA FALLS-LAWTON AND SHERMAN SHEETS

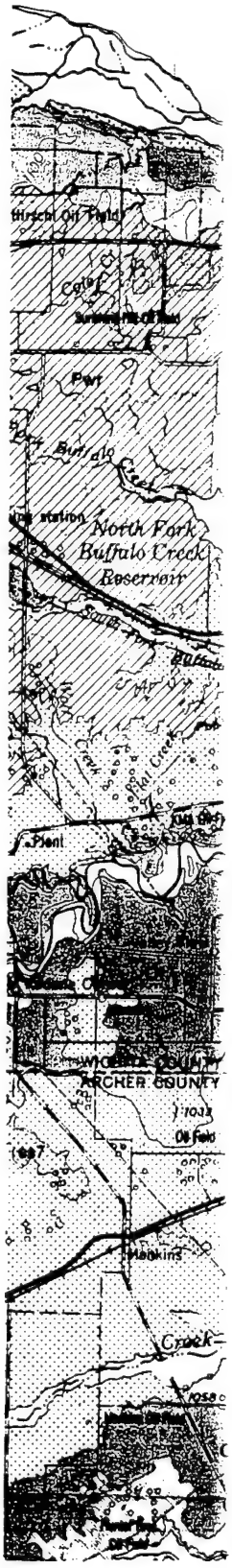


This figure is a schematic diagram that illustrates stratigraphic relationships of mappable rock units in outcrop. Also, it is not a cross section. Limestone units are used as datum beds. Formation boundaries within the Cisco and Albany Groups coincide with those of the adjacent Abilene Sheet to the south and are defined by prominent limestone marker beds. Owing to regional facies changes along strike, most of these beds systematically pinch out in the central portion of the map area. Mappable sandstone units that are most closely correlated with the northern terminations of limestone marker beds define the boundaries of most formations of the Bowie and Wichita Groups.

All units mapped on the Wichita Falls - Lawton and Sherman Sheets are noted by respective map symbols. Named units (commonly shales, also coal beds) that are *not* mapped are labeled on this diagram. Shales may be located on the map by adjacent, mapped sandstone or limestone beds. Sandstone and limestone units less than 10 feet thick are not necessarily to scale.

Alternate formational classifications used by earlier workers are listed in red for the Canyon, Cisco, Albany and Clear Fork Groups. Minor revisions of Cisco formation boundaries have been made to facilitate mapping and cartography. Dashed red line marks the approximate map boundary between the Wichita Falls - Lawton (left) and Sherman (right) Sheets.

Owing to extreme vertical exaggeration, stratigraphic relationships between members, particularly sandstones, are necessarily schematic.



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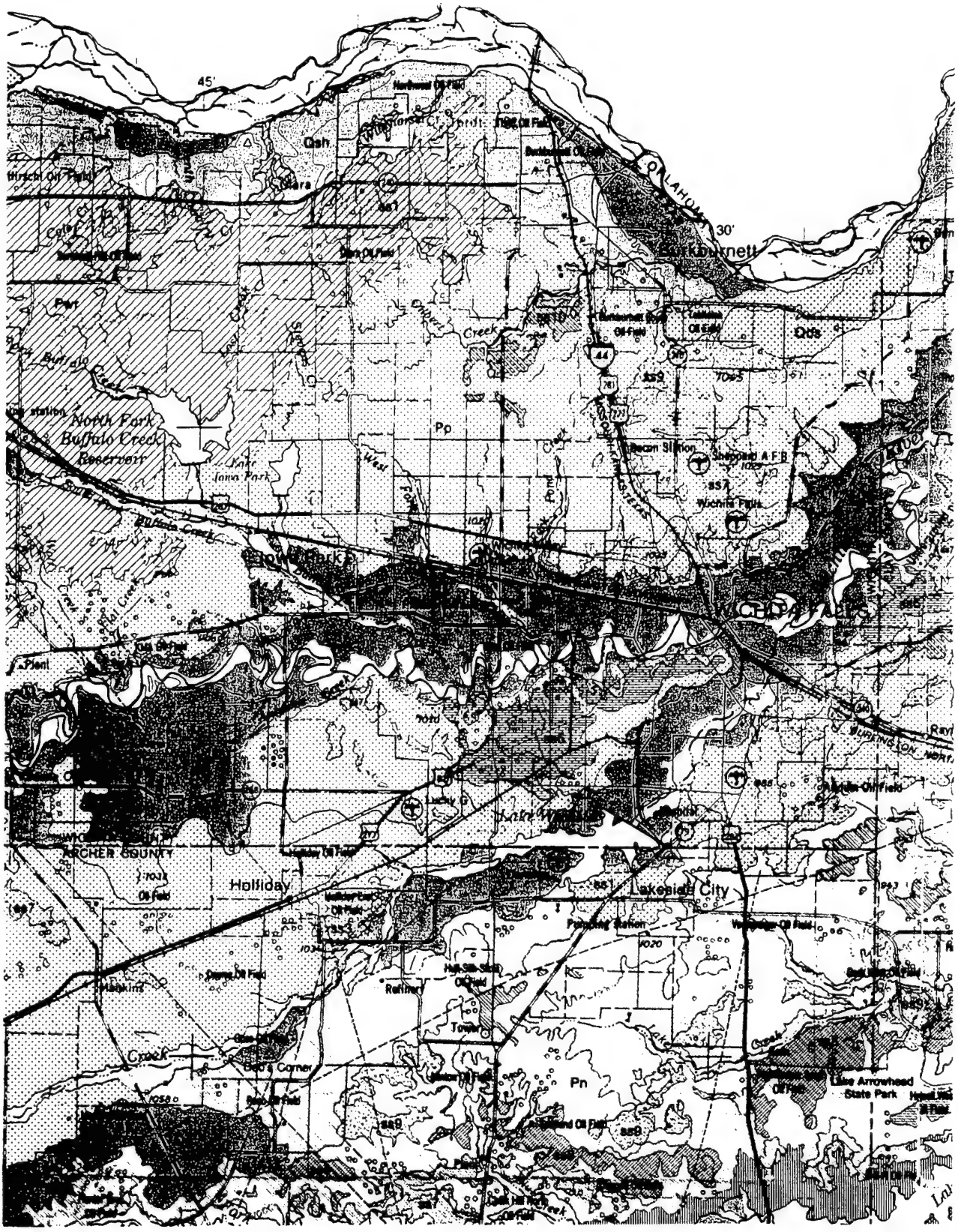
GEOLOGI

(1)

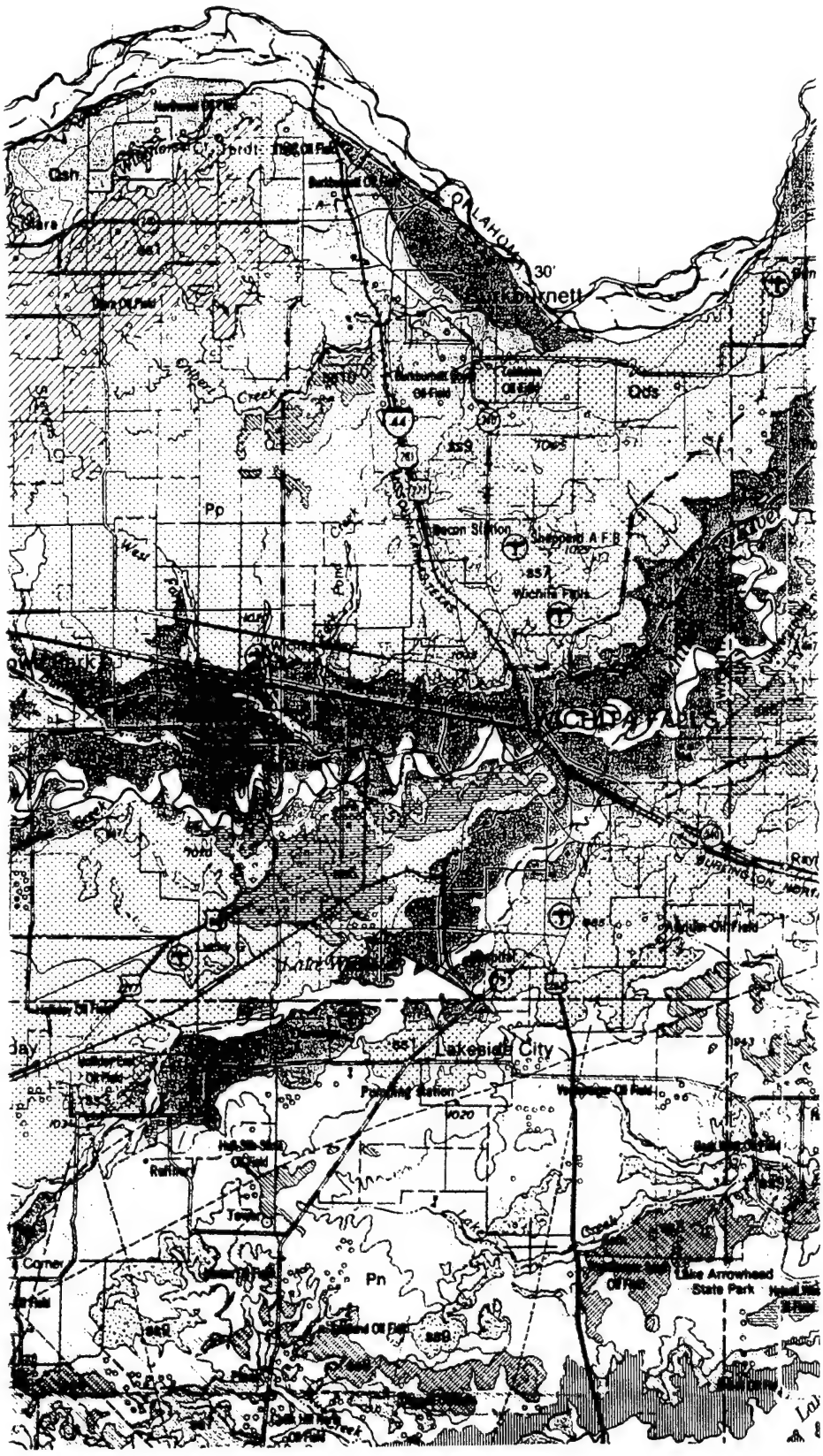


GEOLOGIC ATLAS OF TEXAS, WICHITA FALLS-LAWTON (PARTIAL)

ALFRED SHERWOOD ROMER MEMORIAL EDITION

1987

(2)



Scale 1:250,000

5 10 15 20 Statute Miles

5 10 15 20 25 30 Kilometers

CONTOUR INTERVAL 100 FEET
TRANSVERSE MERCATOR PROJECTION

...S OF TEXAS, WICHITA FALLS-LAWTON (PARTIAL)

ALFRED SHERWOOD ROMER MEMORIAL EDITION

1987

(3)

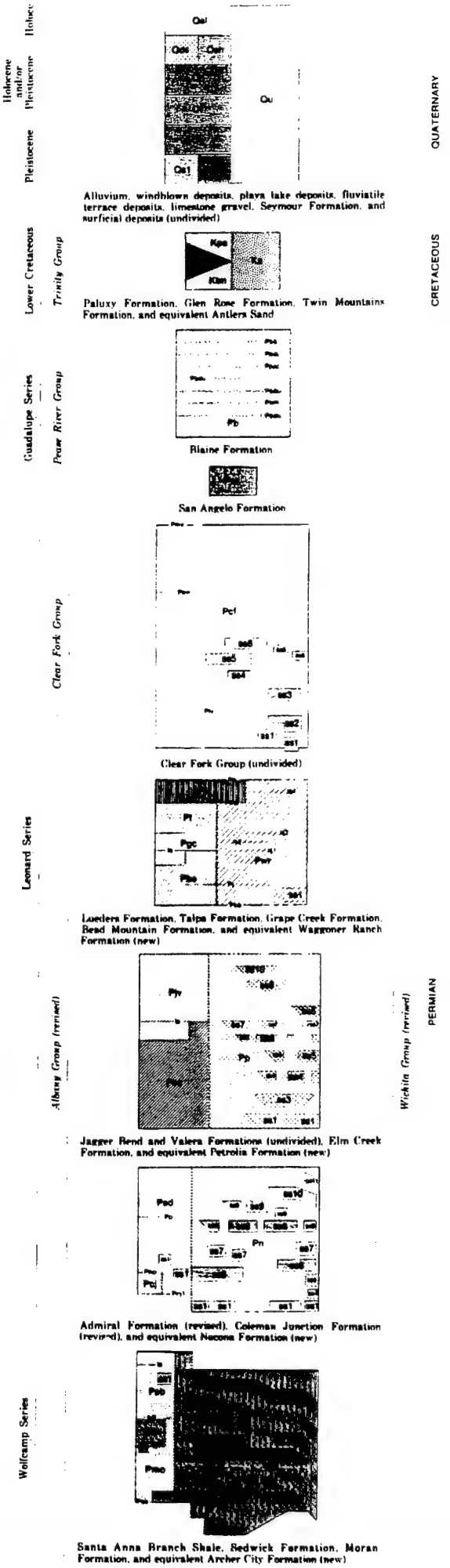


EXHIBIT 1

LAKE WICHITA
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PHOTOGRAPHS

EXHIBIT 2

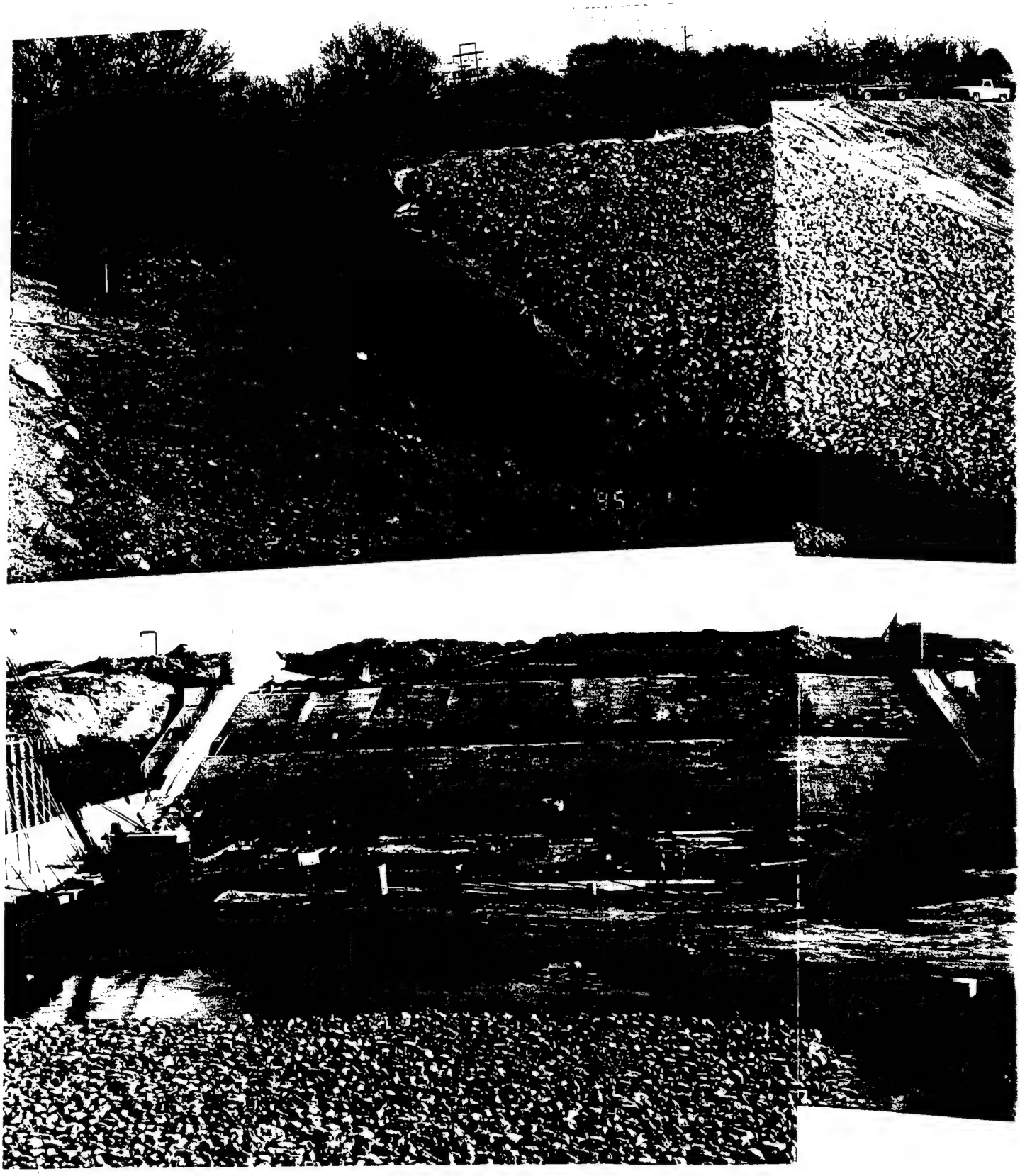
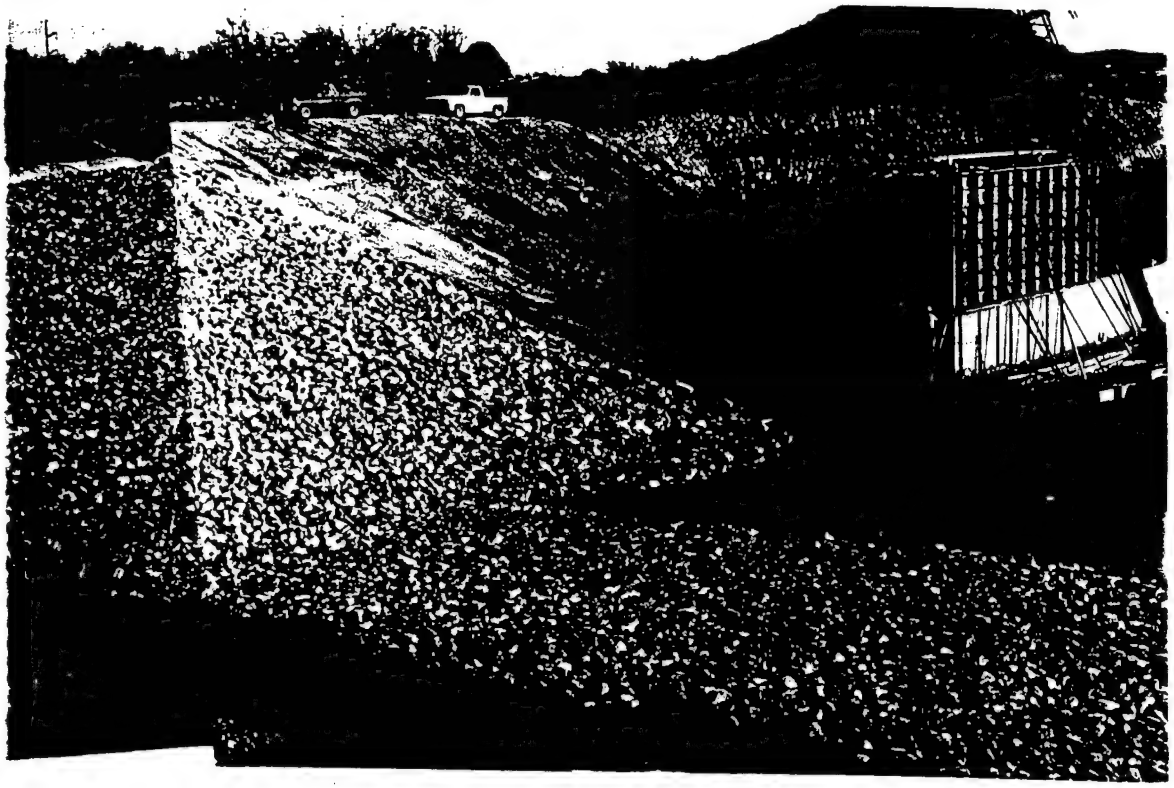
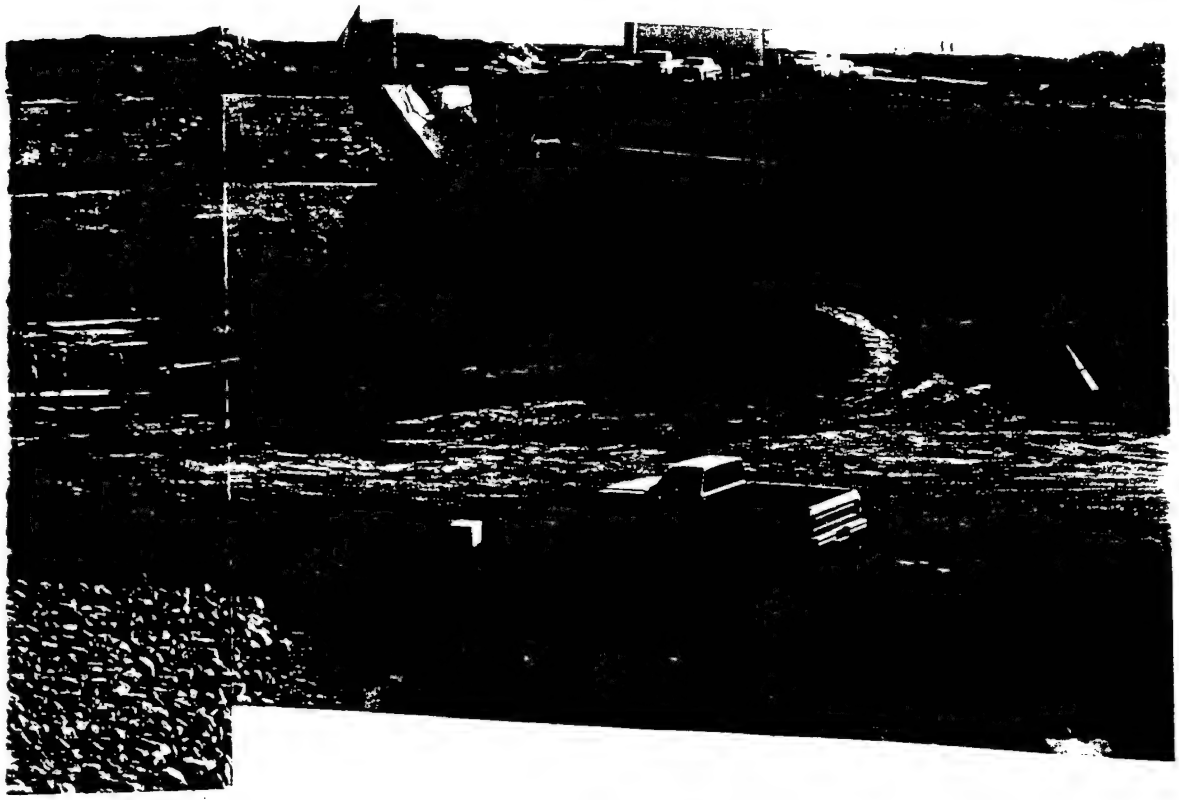


Photo 1. Composite view of the downstream portion of the main spillwa
25 JANUARY 1995





e downstream portion of the main spillway channel.
5 JANUARY 1995

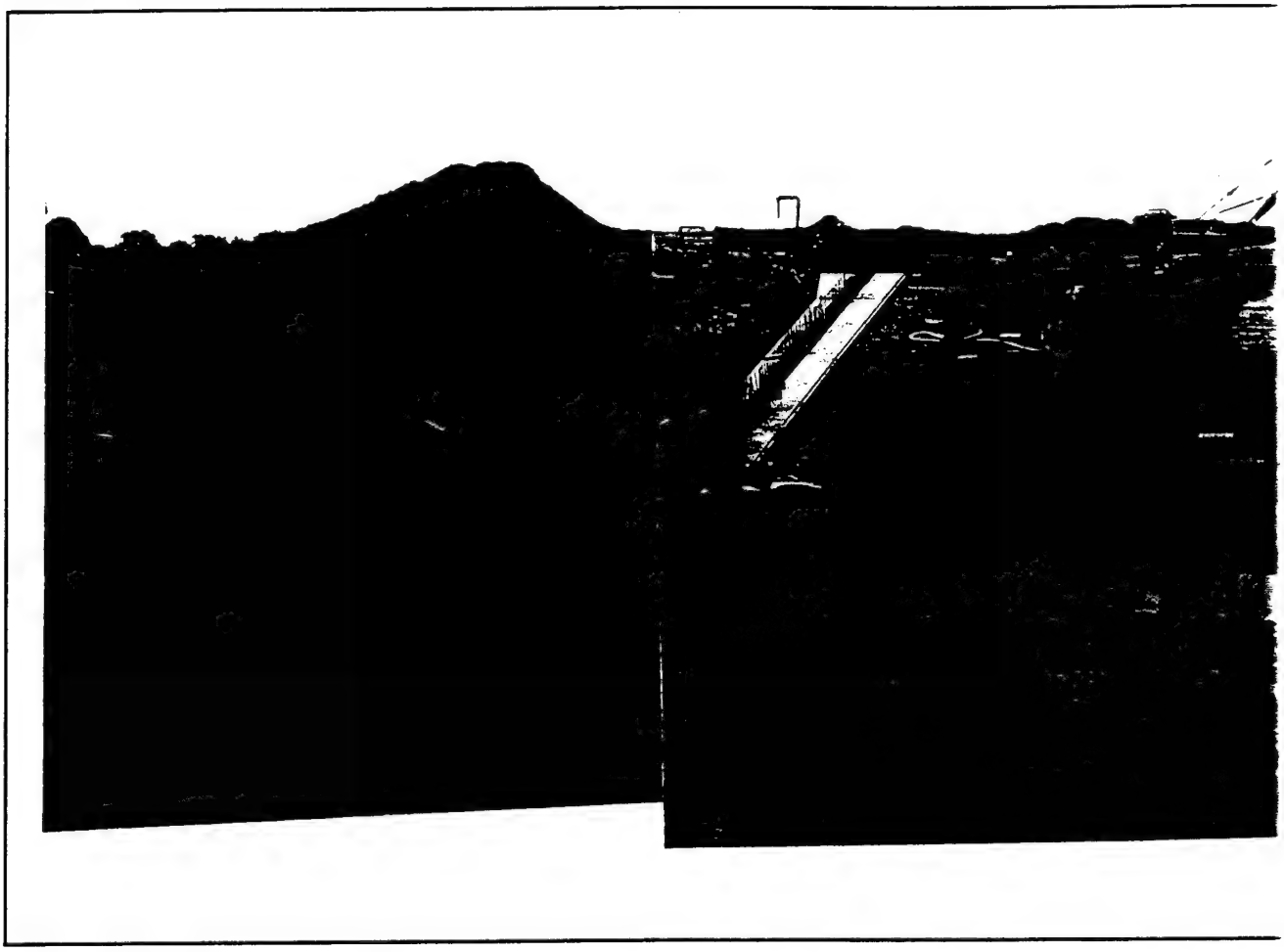


Photo 2. Composite view of the

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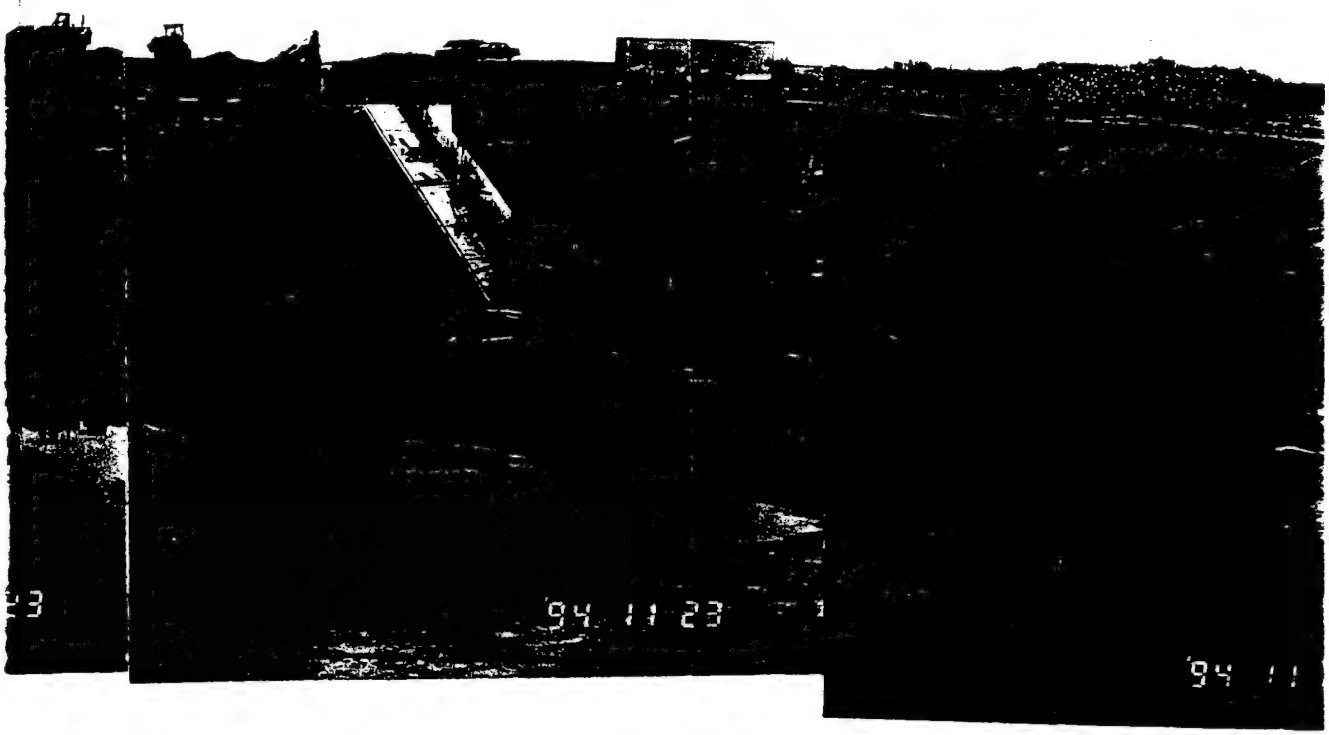
Photo 2. Composite view of the downstream portion of the main spillway channel.

23 NOVEMBER 1994



portion of the main spillway channel.

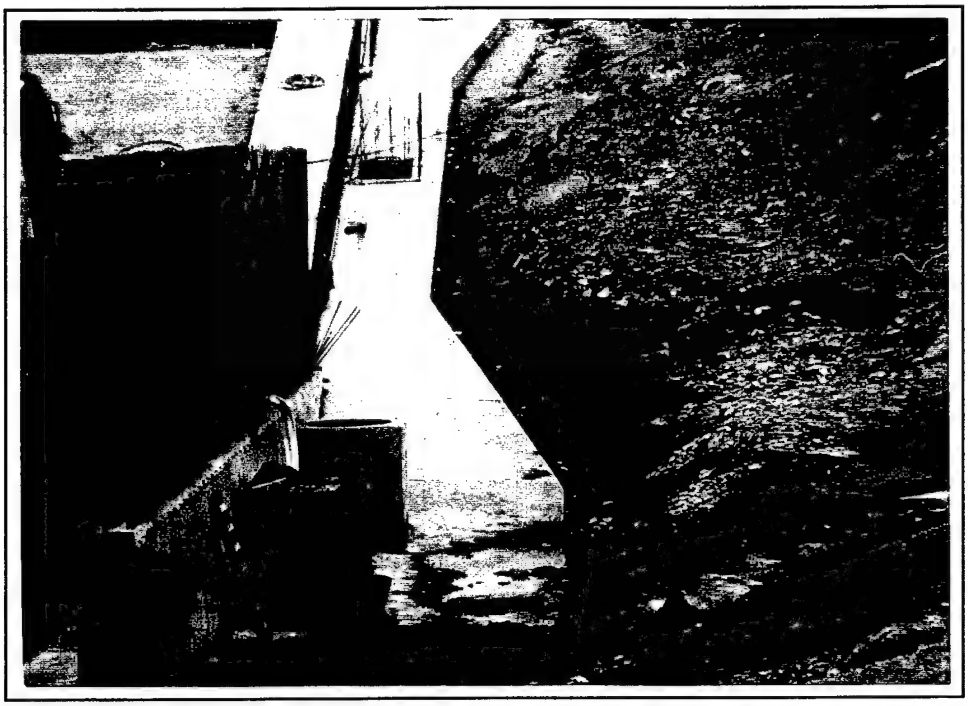


Photo 3. Wet spot on the left side of the spillway at base of the sandstone.

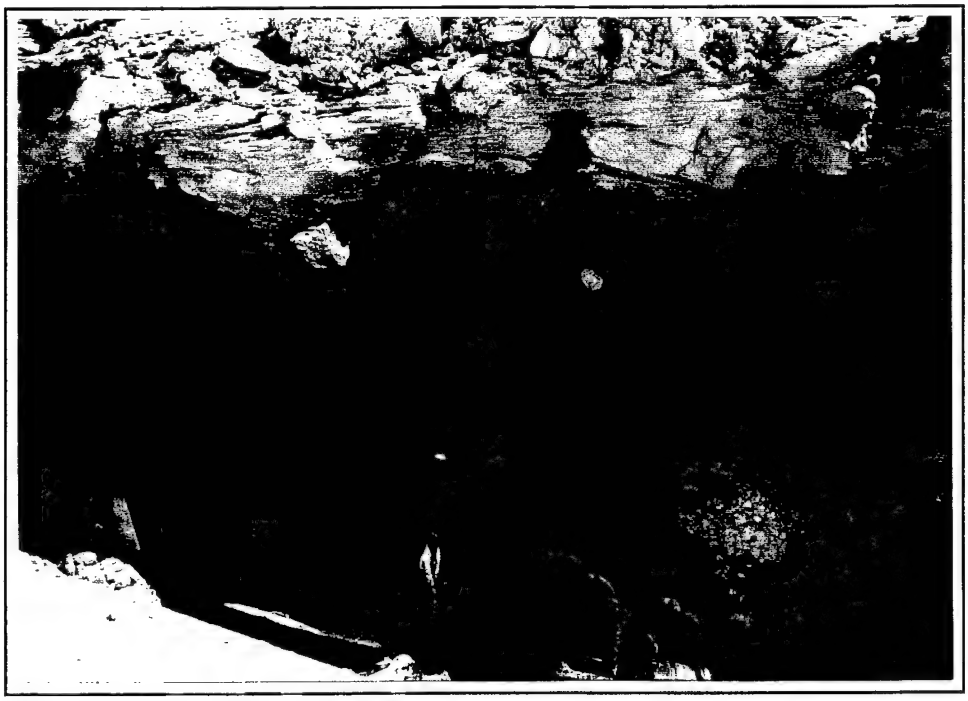


Photo 4. Close-up of wet spot shown in photo 3.

Photo 5. Wet spot on the left side of the spillway at fracture in the sandstone.

Photo 6. Wet spot on the right side of the spillway below the stockpond. Note wet area within the loose material on the left side of photo.

Photo 7. Area above wet spot on the right side of the spillway after some detritus removed. Note wet sections in sandstone on left and center of photo.

Photo 8. Close-up of area near the center of photo 7.

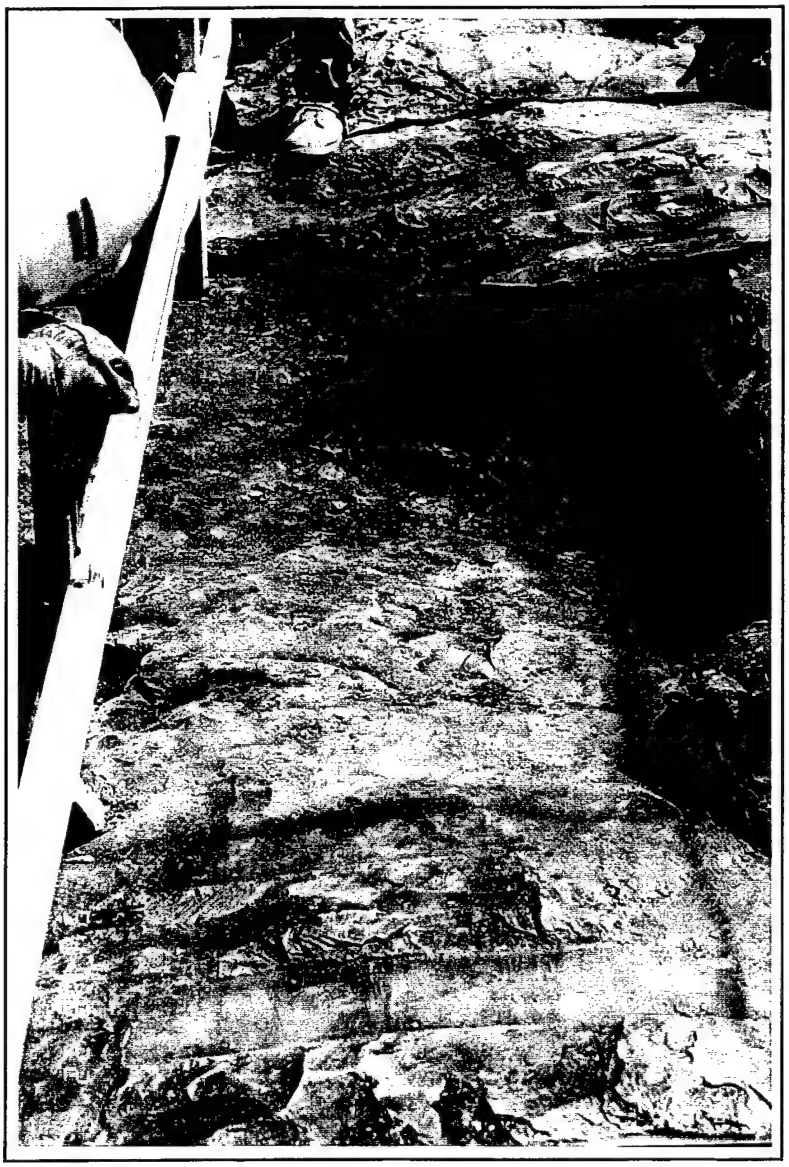


Photo 9. Station 415+88 to 415+90, 40 to 50 feet right of centerline showing the blocky, non-fissionable structure of the claystone.

Photo 10. Record photo of foundation at Station 415+57 to 415+61, 94 to 99 feet left of centerline. Note slickensides in the claystone above the number "6".

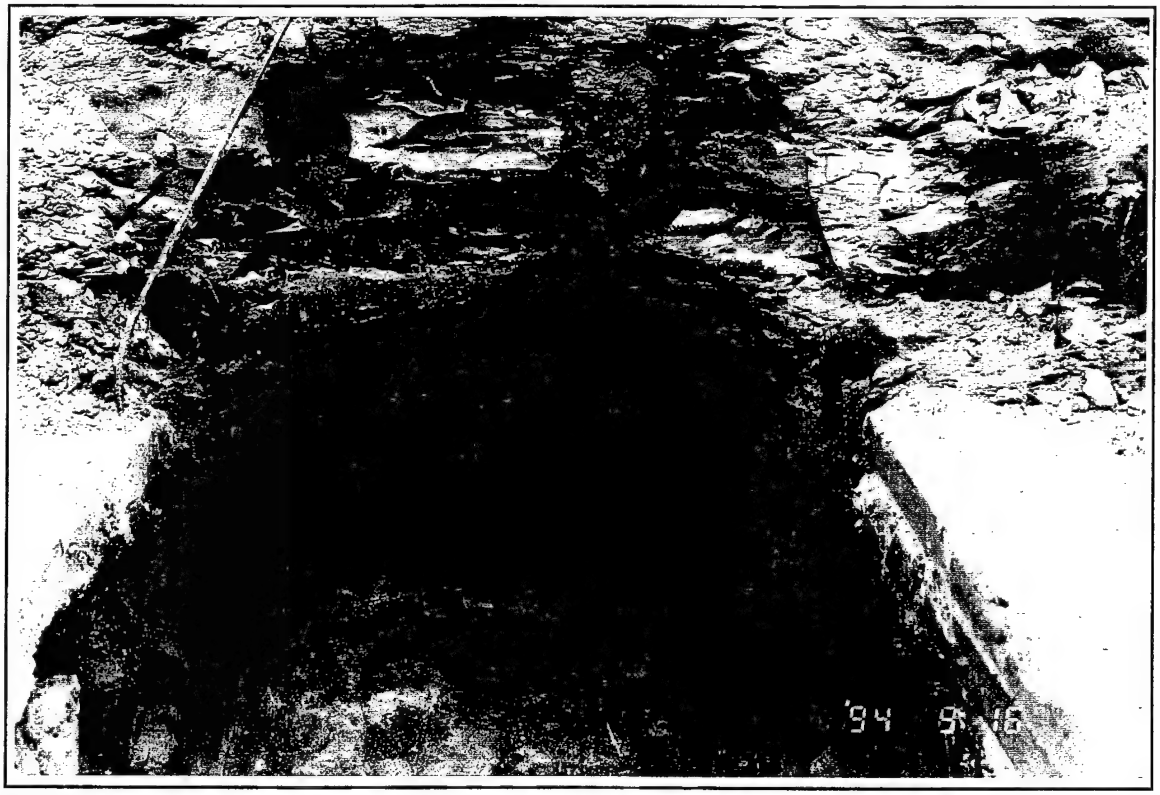


Photo 11. Record photo of foundation at Station 416+50 to 416+54, 117 feet left of centerline to the end of the trench. Note variegated claystone.

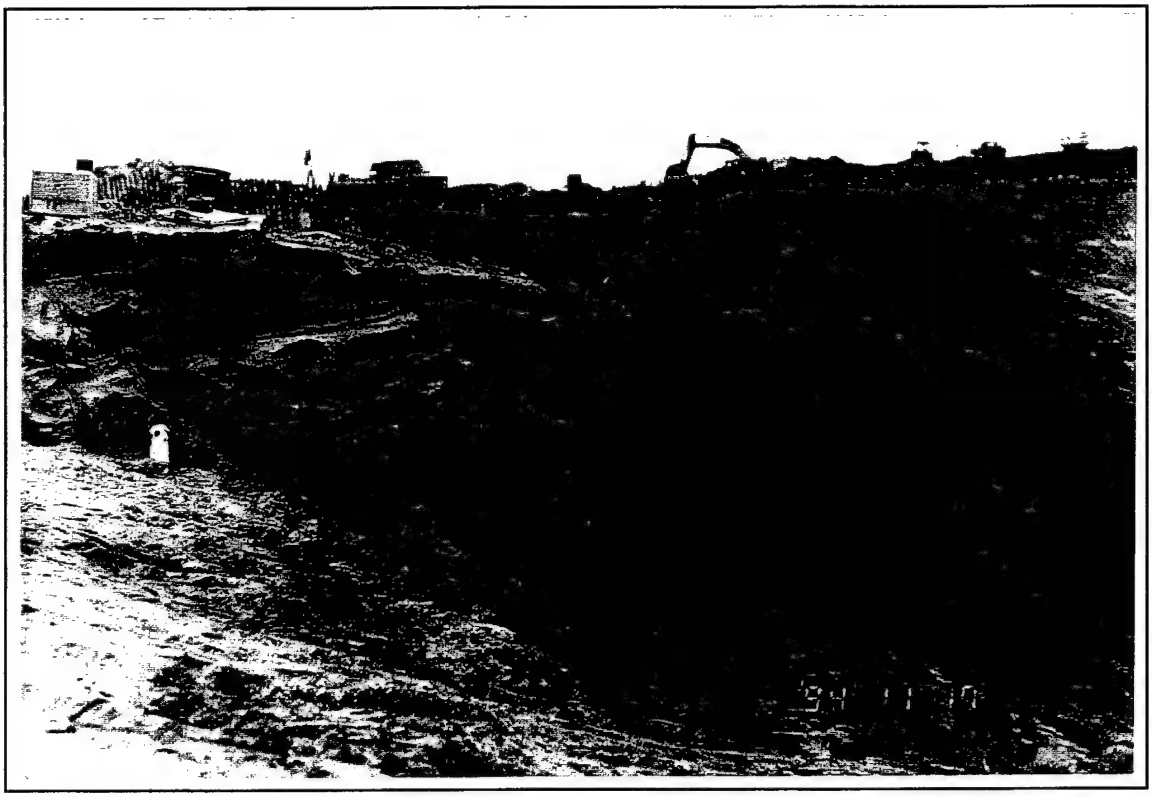


Photo 12. Vertical cut in spillway excavation 44 feet left of centerline, Station 415+90 to 416+00. Note the relationship of the different rock strata within the cut.

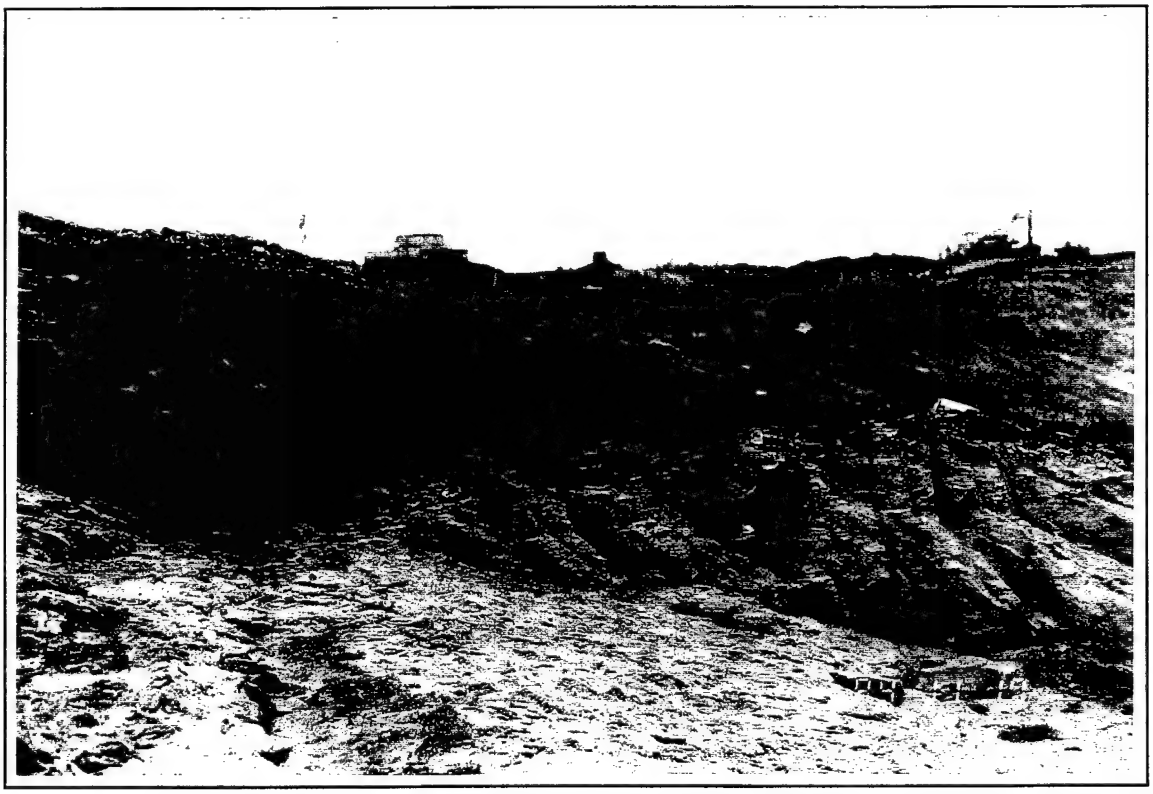


Photo 13. Vertical cut 43 feet left of centerline Station 415+80 to 415+90. Note the same relationships as in photo 12. Red claystone is common in both areas.

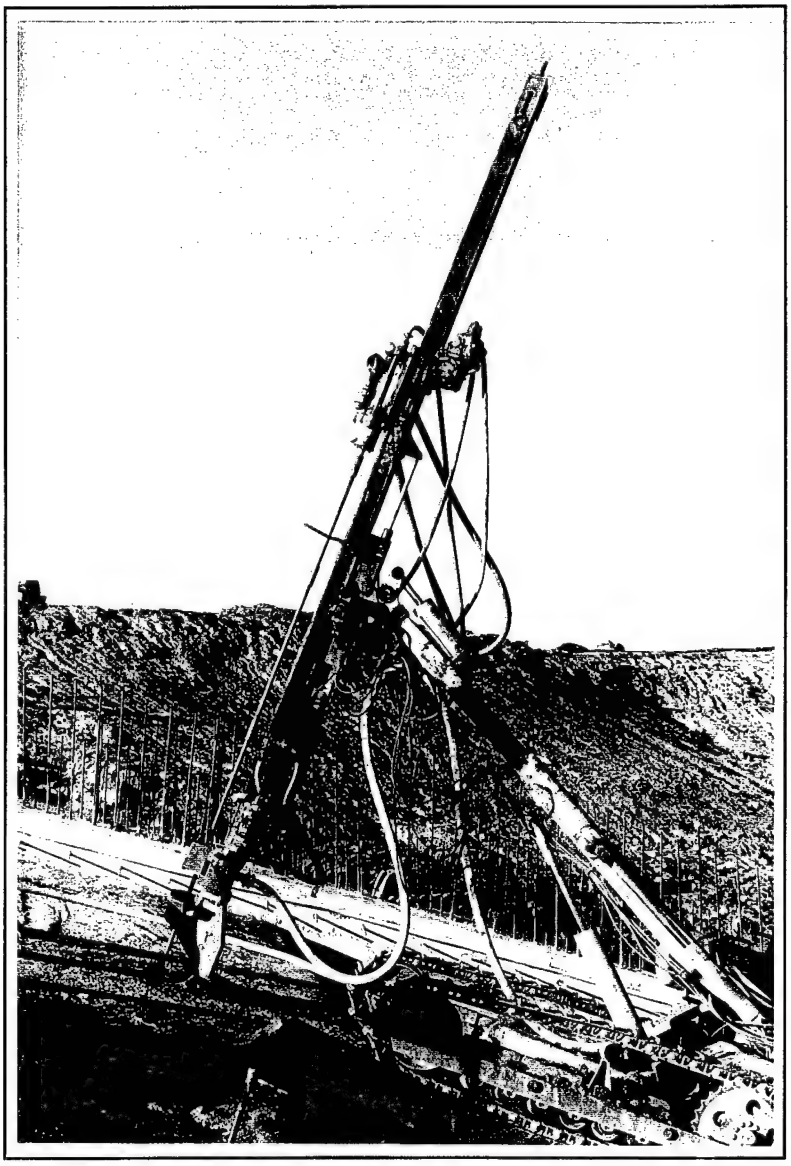


Photo 14. Drilling anchor holes.

Photo 15. Setup for the anchor pullout test.

Photo 16. Anchor pullout test.

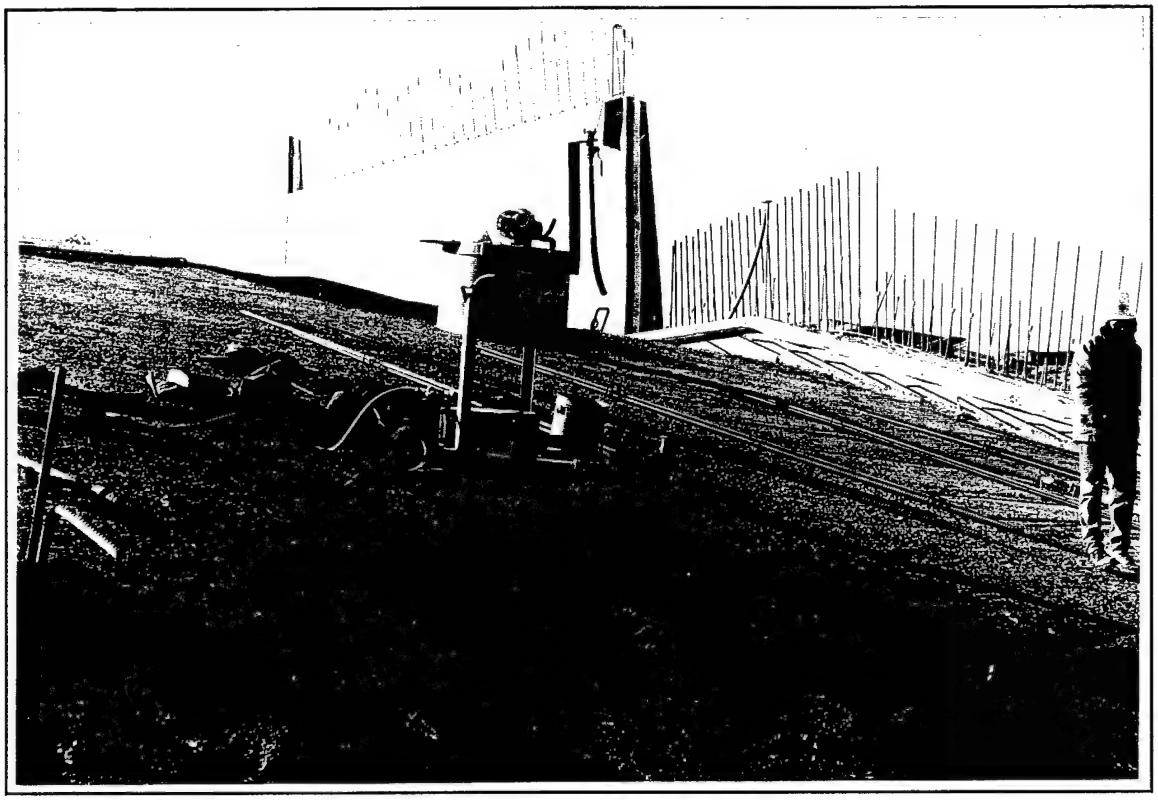
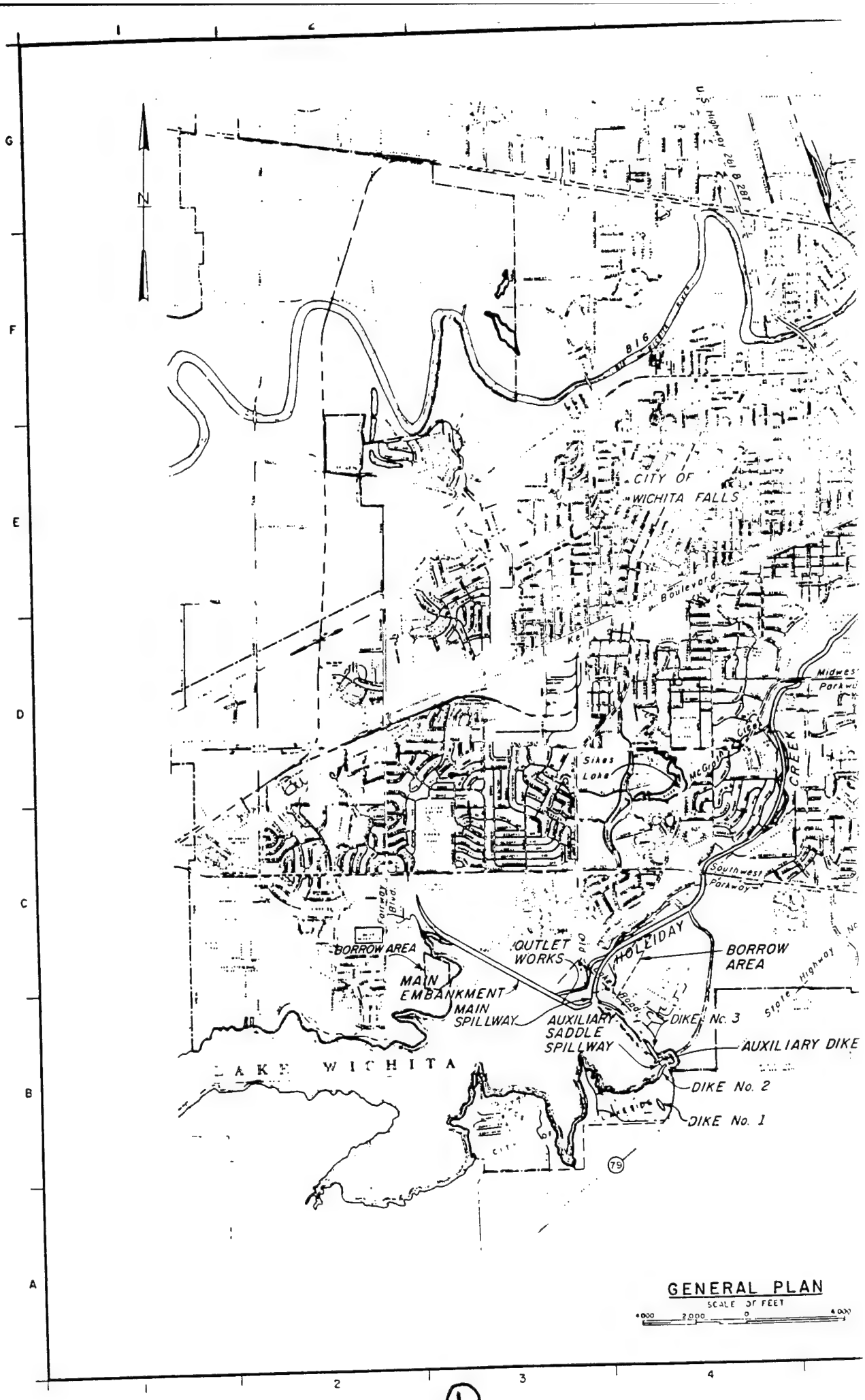


Photo 17. Setup for grouting the anchors.

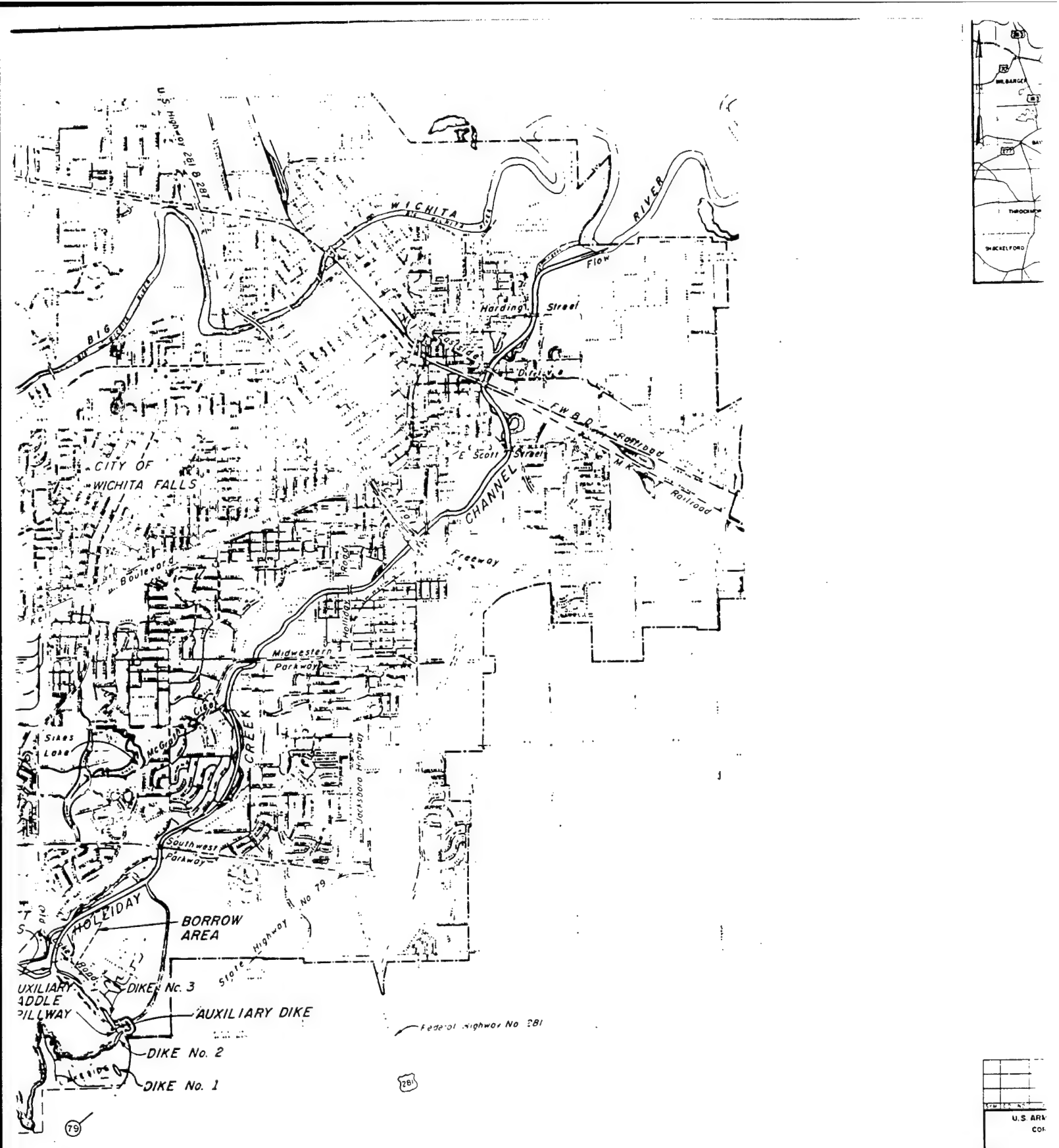
Photo 18. Inplace anchors.

LAKE WICHITA
HOLLIDAY CREEK, WICHITA FALLS, TEXAS
SPILLWAY FOUNDATION REPORT

PLATES


N
U.S. Highway 281 & 287
B16
CITY OF
WICHITA FALLS
Boulevard
Midwes
Parkwa
SIKES
LAKE
McGLOIN
CREEK
Southwest
Parkway
Fairway Blvd.
BORROW AREA
OUTLET
WORKS
DIO
HOLLIDAY
BORROW
AREA
MAIN
EMBANKMENT
MAIN
SPILLWAY
AUXILIARY
SADDLE
SPILLWAY
DIKE No. 3
AUXILIARY DIKE
LAKE WICHITA
DIKE No. 2
DIKE No. 1
79
State Highway
GENERAL PLAN
SCALE OF FEET
4000
2000
0
4000
G
F
E
D
C
B
A
1
2
3
4

(1)



GENERAL PLAN

SCALE OF FEET

4000 2000 0 4000

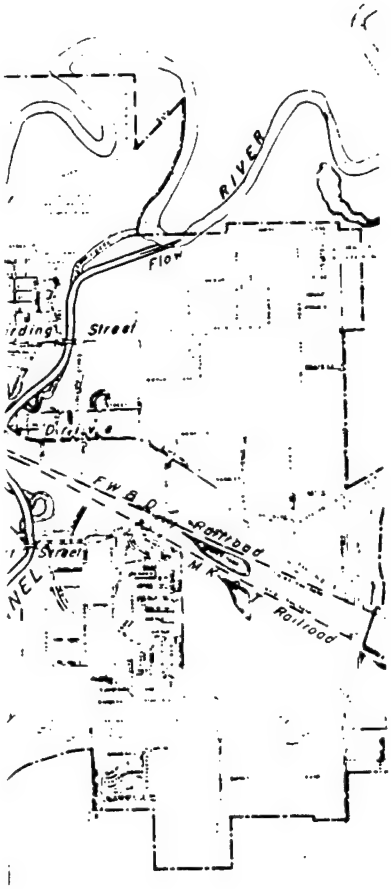
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

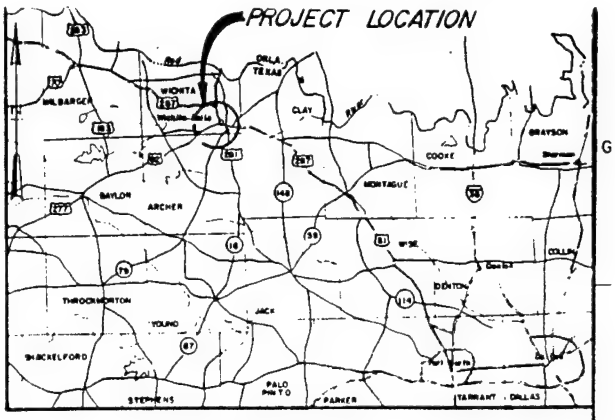
U.S. ARM
COR

DESIGNED BY
R. SANCHEZ
DRAWN BY
B.G.M.H.
CHECKED BY
CARM.JR.
SUBMITTED BY
ENGINEER

4 5 6 7 8

(2)





VICINITY MAP

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

SYM	NO	ACTION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS

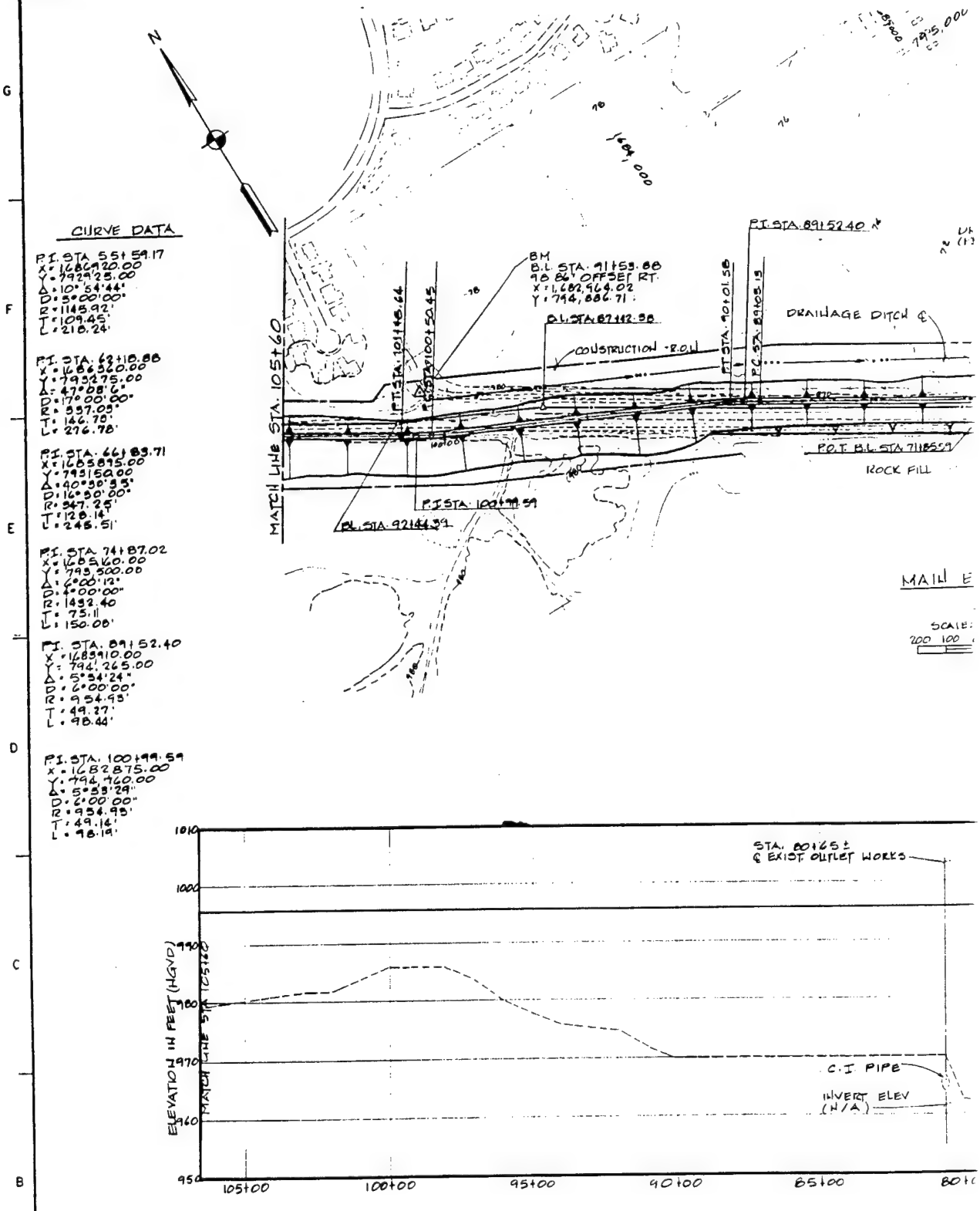
DESIGNED BY: R. SANCHEZ
DRAWN BY: B. SMITH
CHECKED BY: CARMICHAEL
SUBMITTED BY:
ENGINEER

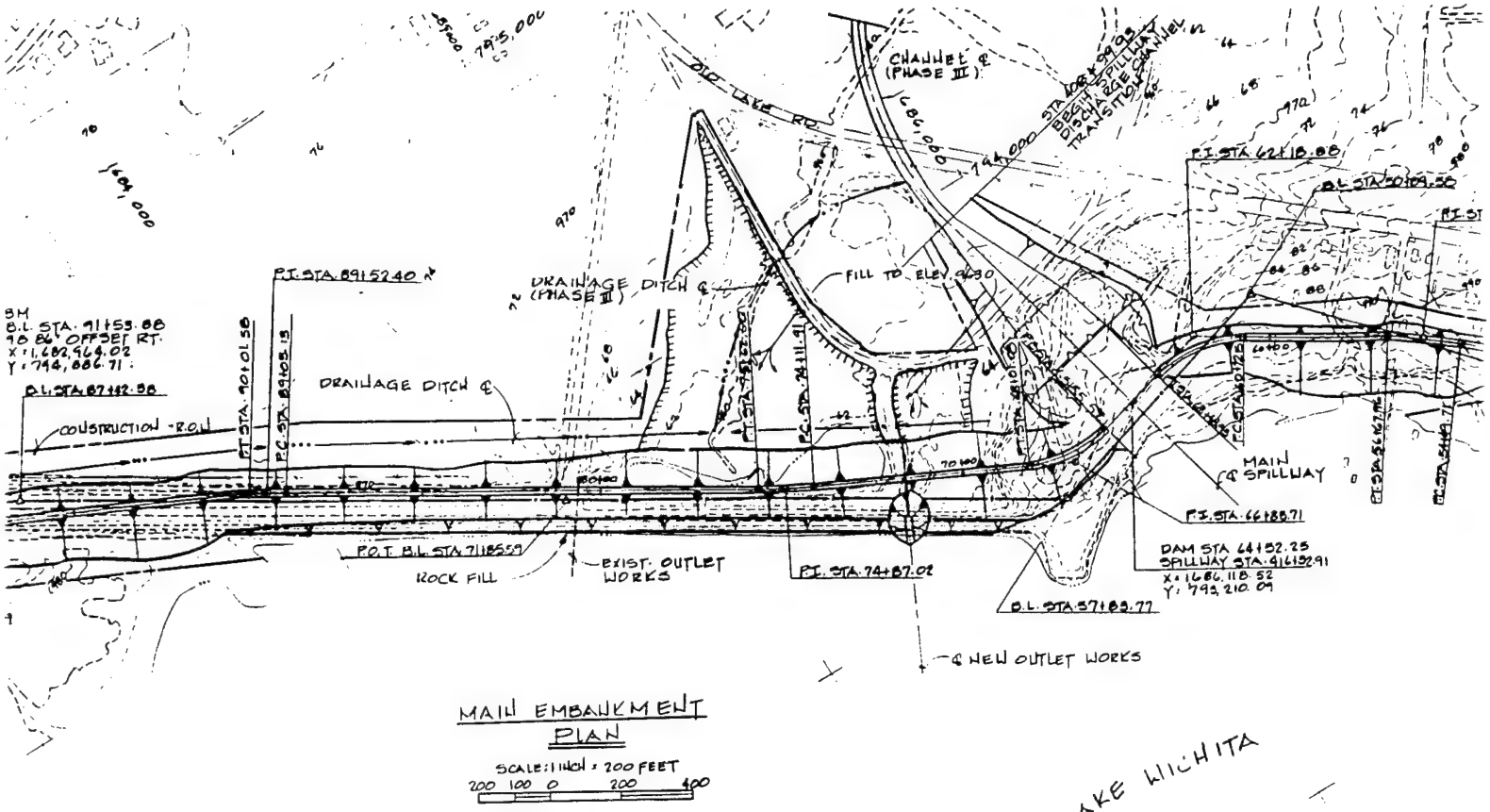
RED RIVER WATERSHED
LAKE WICHITA
HOLLIDAY CREEK, WICHITA FALLS, TEXAS
LOCAL FLOOD PROTECTION PHASE III

GENERAL PLAN AND VICINITY MAP

NV. NO. DACW56-92-B-0032 DATED
CONTR NO
DRAWING NUMBER: BE360-D3-1.1
SHEET NO
SEQUENCE NO
CONTR NO

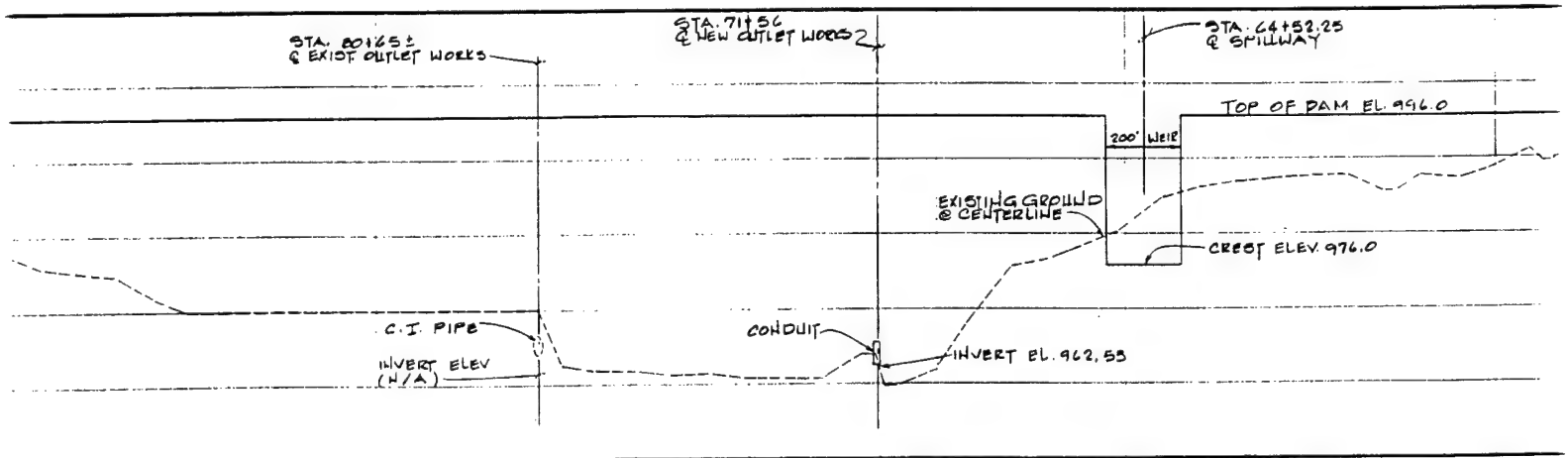
PLATE 1


N
CURVE DATA
P.I. STA 55+59.17
X = 1686920.00
Y = 792925.00
Δ = 10° 54' 44"
D = 5° 00' 00"
R = 1145.92'
T = 109.45'
L = 218.24'
P.I. STA. 62+18.88
X = 1686320.00
Y = 793275.00
Δ = 47° 08' 6"
D = 17° 00' 00"
R = 337.09'
T = 146.70'
L = 276.78'
P.I. STA. 66+83.71
X = 1685895.00
Y = 793150.00
Δ = 40° 30' 55"
D = 16° 30' 00"
R = 347.25'
T = 128.14'
L = 245.51'
P.I. STA. 74+87.02
X = 1685160.00
Y = 793,500.00
Δ = 6° 00' 12"
D = 4° 00' 00"
R = 1432.40
T = 75.11'
L = 150.00'
P.I. STA. 89+52.40
X = 1683910.00
Y = 794,265.00
Δ = 5° 54' 24"
D = 6° 00' 00"
R = 954.93'
T = 49.27'
L = 98.44'
P.I. STA. 100+99.59
X = 1682875.00
Y = 794,960.00
Δ = 5° 53' 29"
D = 6° 00' 00"
R = 954.93'
T = 49.14'
L = 98.19'
MATCH LINE STA. 105+60
P.I. STA. 101+15.64
P.C. STA. 100+50.45
BM
B.L. STA. 91+59.88
98.86' OFFSET RT.
X = 1,682,964.02
Y = 794,886.71
P.I. STA. 89+52.40
P.I. STA. 90+01.58
P.C. STA. 89+05.19
DRAINAGE DITCH ℄
CONSTRUCTION R.O.W.
P.O.T. B.L. STA 71+85.59
ROCK FILL
P.I. STA. 100+99.59
B.L. STA. 92+44.39
MAIN E
SCALE:
200 100
STA. 80+65 ±
℄ EXIST. OUTLET WORKS
C.I. PIPE
INVERT ELEV
(N/A)
ELEVATION IN FEET (NGVD)
MATCH LINE STA 105+60
1010
1000
990
980
970
960
950
105+00
100+00
95+00
90+00
85+00
80+
G
F
E
D
C
B
A
1
2
3
4
(1)

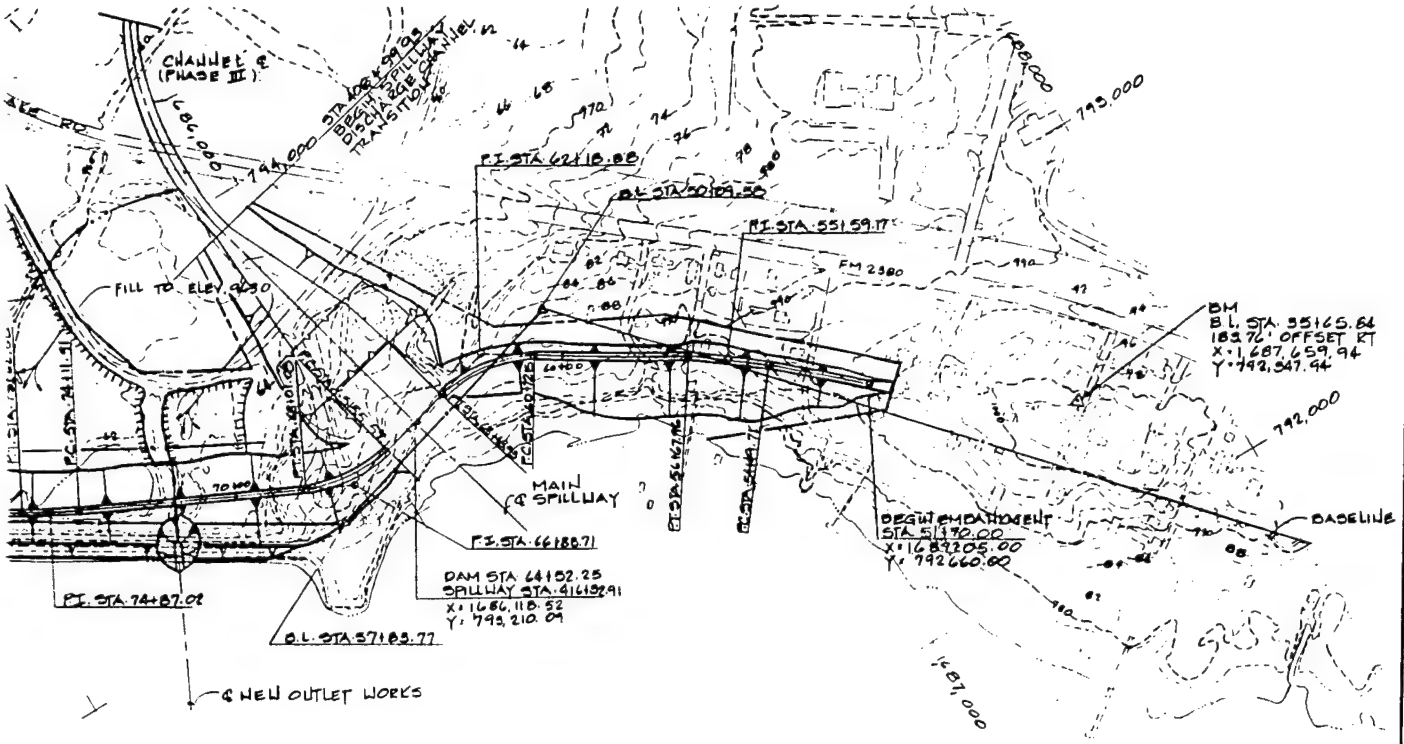


MAIN EMBANKMENT
PLAN

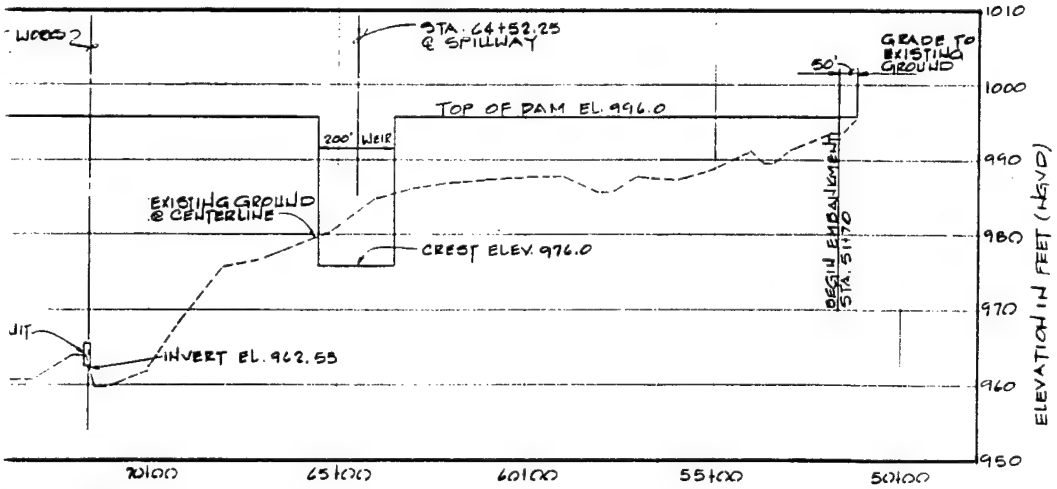
SCALE: 1 INCH = 200 FEET
200 100 0 200 400



PROFILE
MAIN EMBANKMENT



LAKE WICHITA



N STATIONS

FILE

EMBANKMENT

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

REVISION NO.	REVISION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

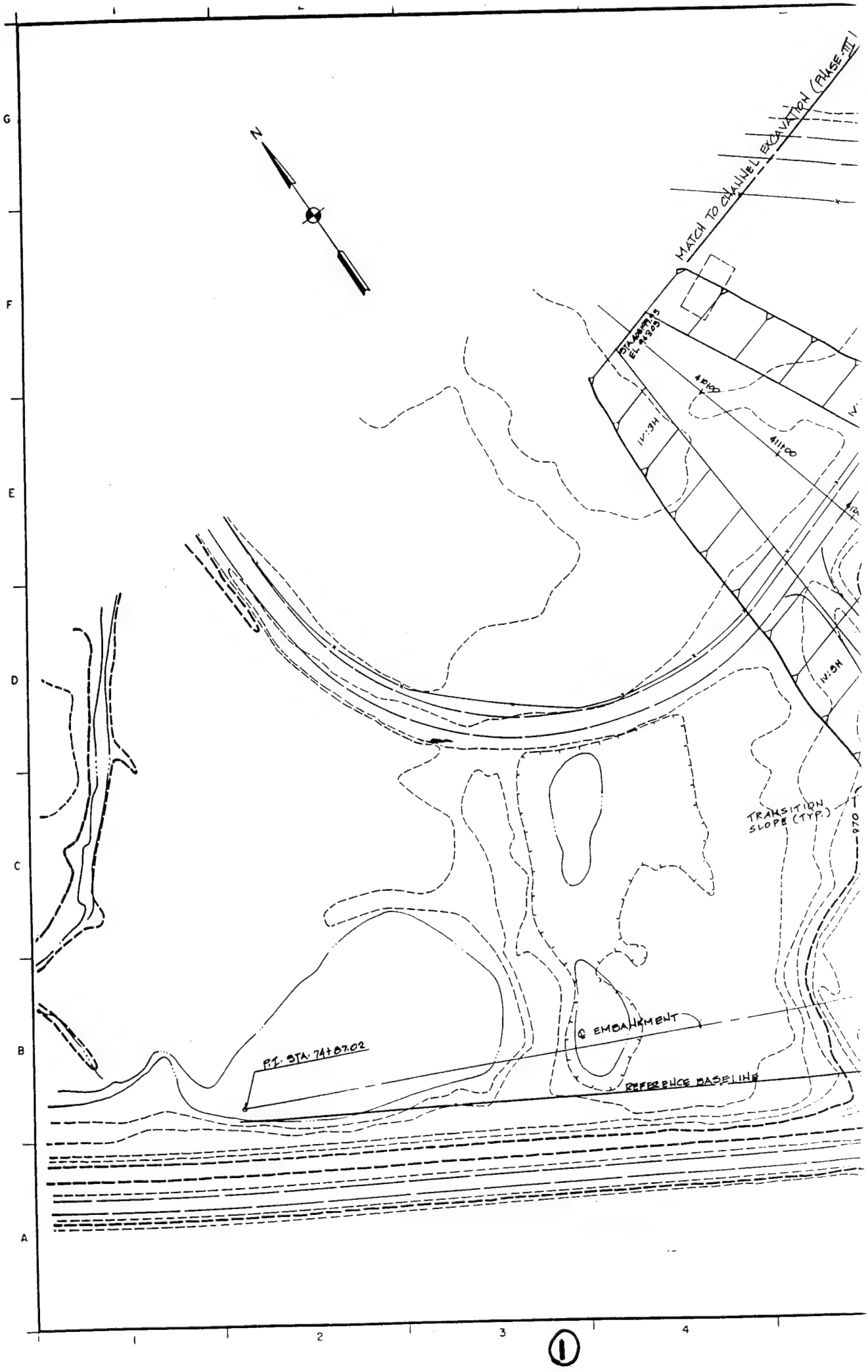
DESIGNED BY: P. FLOEB
DRAWN BY: B. SMITH
REVIEWED BY: R. SANCHEZ
SUBMITTED BY: JACK W. HUSSEY, ENGINEER

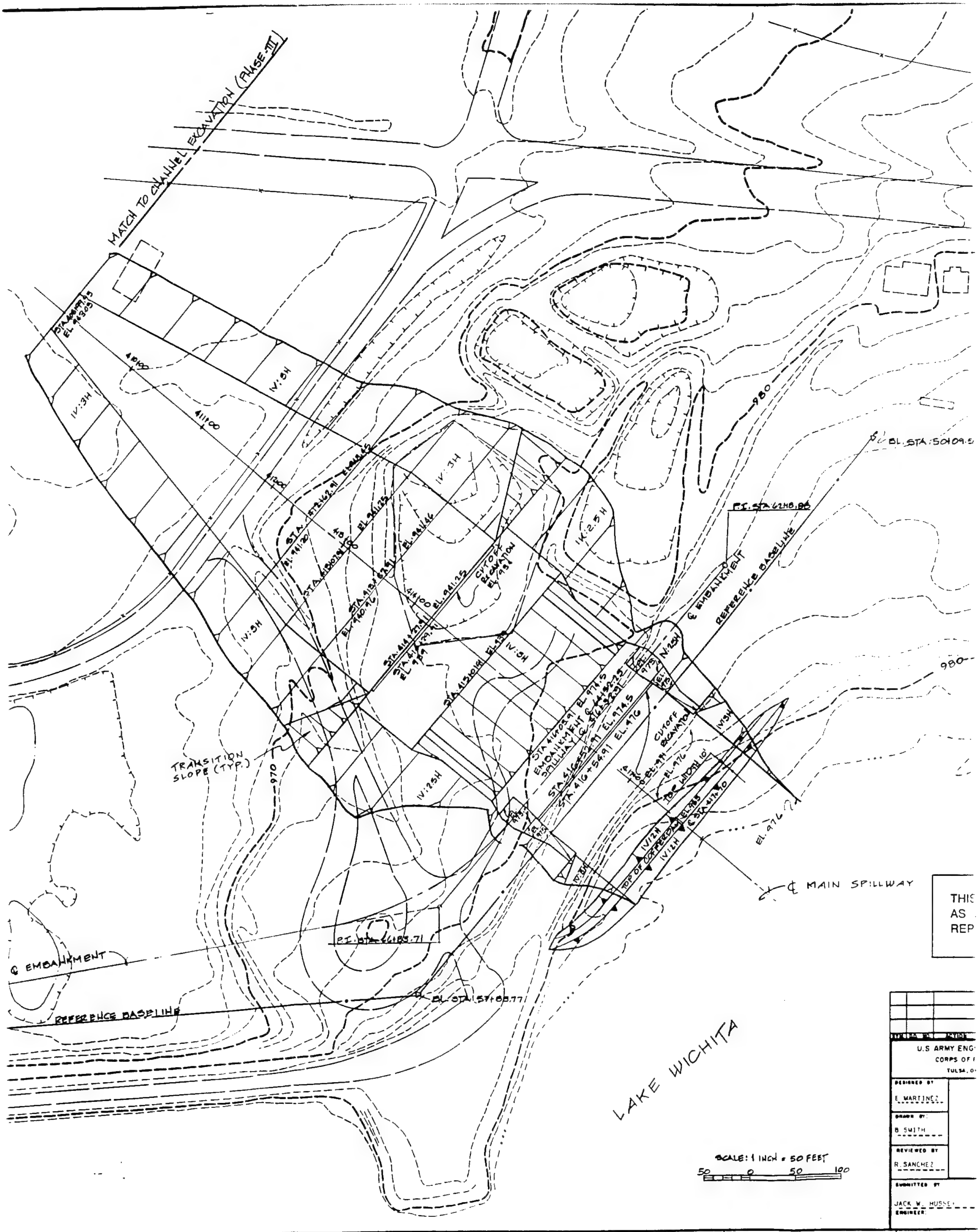
RED RIVER WATERSHED
LAKE WICHITA
HOLLIDAY CREEK, WICHITA FALLS, TEXAS
LOCAL FLOOD PROTECTION PHASE III

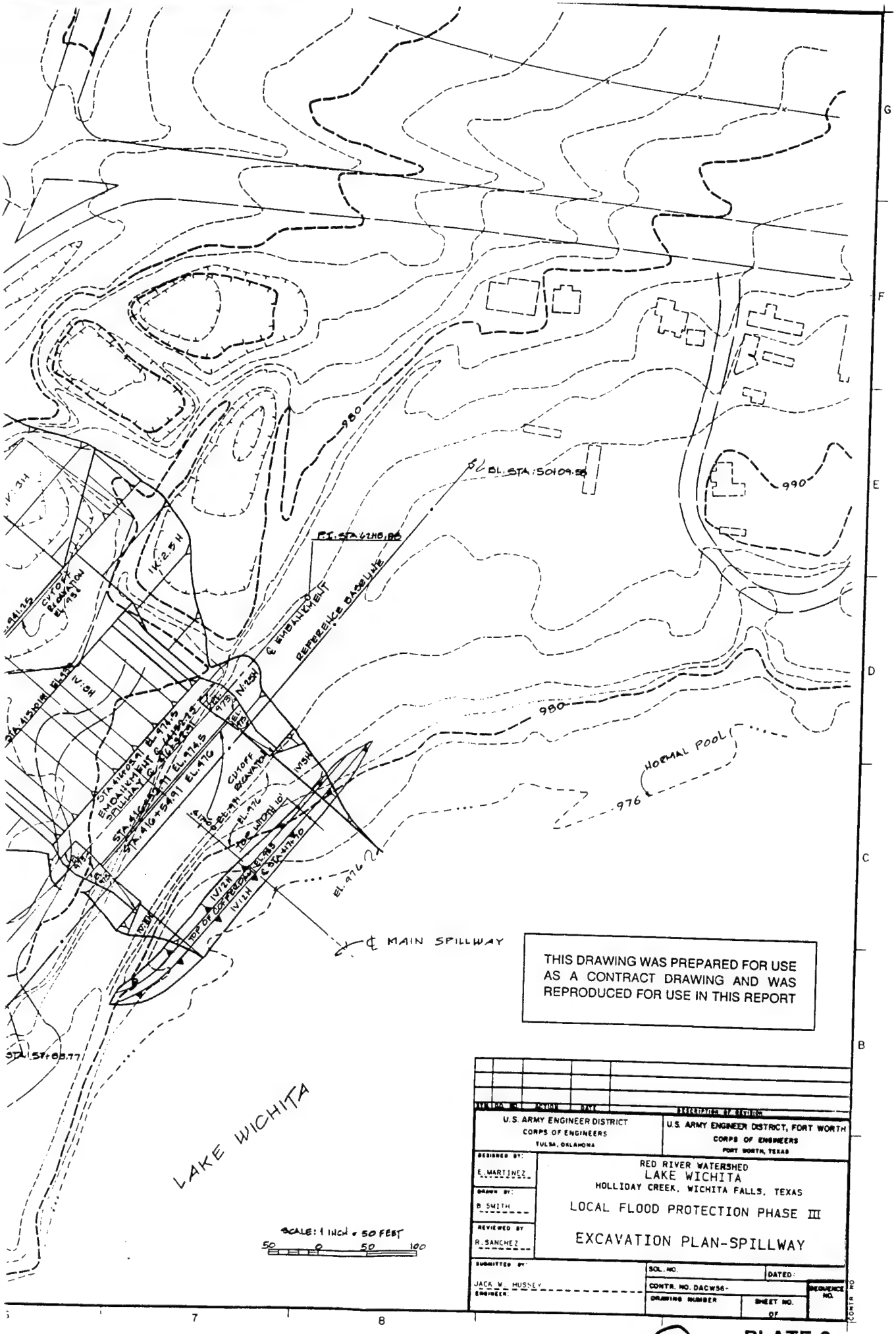
EMBANKMENT PLAN AND PROFILE
(STA. 51+70 TO STA. 105+00)

SOL. NO. | DATED:
CONTR. NO.
DRAWING NUMBER | SHEET NO. OF | SEQUENCE NO.

SOUTH

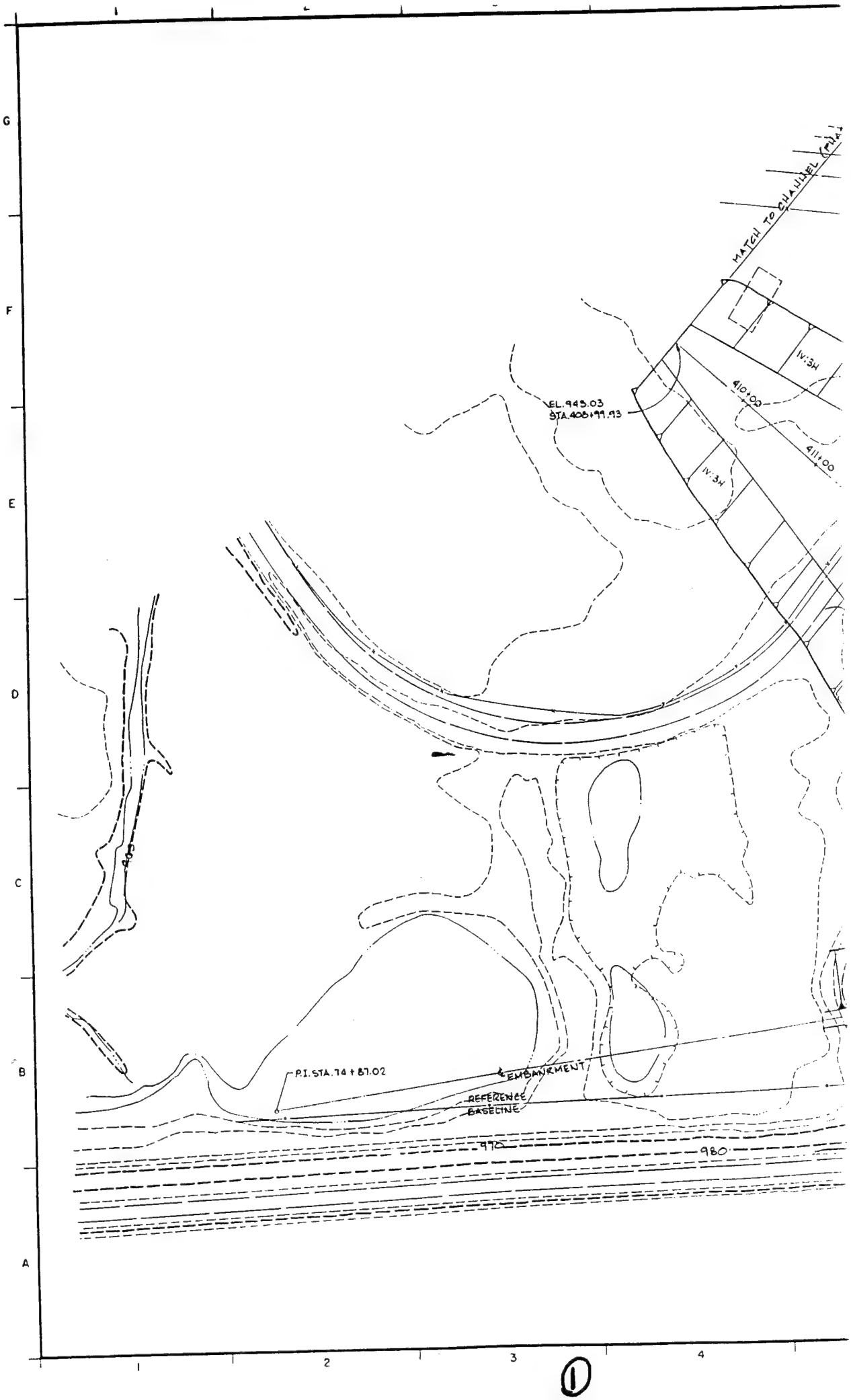

MATCH TO CHANNEL EXCAVATION (PHASE III)
DRAINAGE EL. 4305
4100
4110.00
1V:3H
1V:3H
1V:3H
TRANSITION SLOPE (TYP.)
P.I. STA. 741+07.02
℄ EMBANKMENT
REFERENCE BASELINE
N
G
F
E
D
C
B
A
1
2
3
4

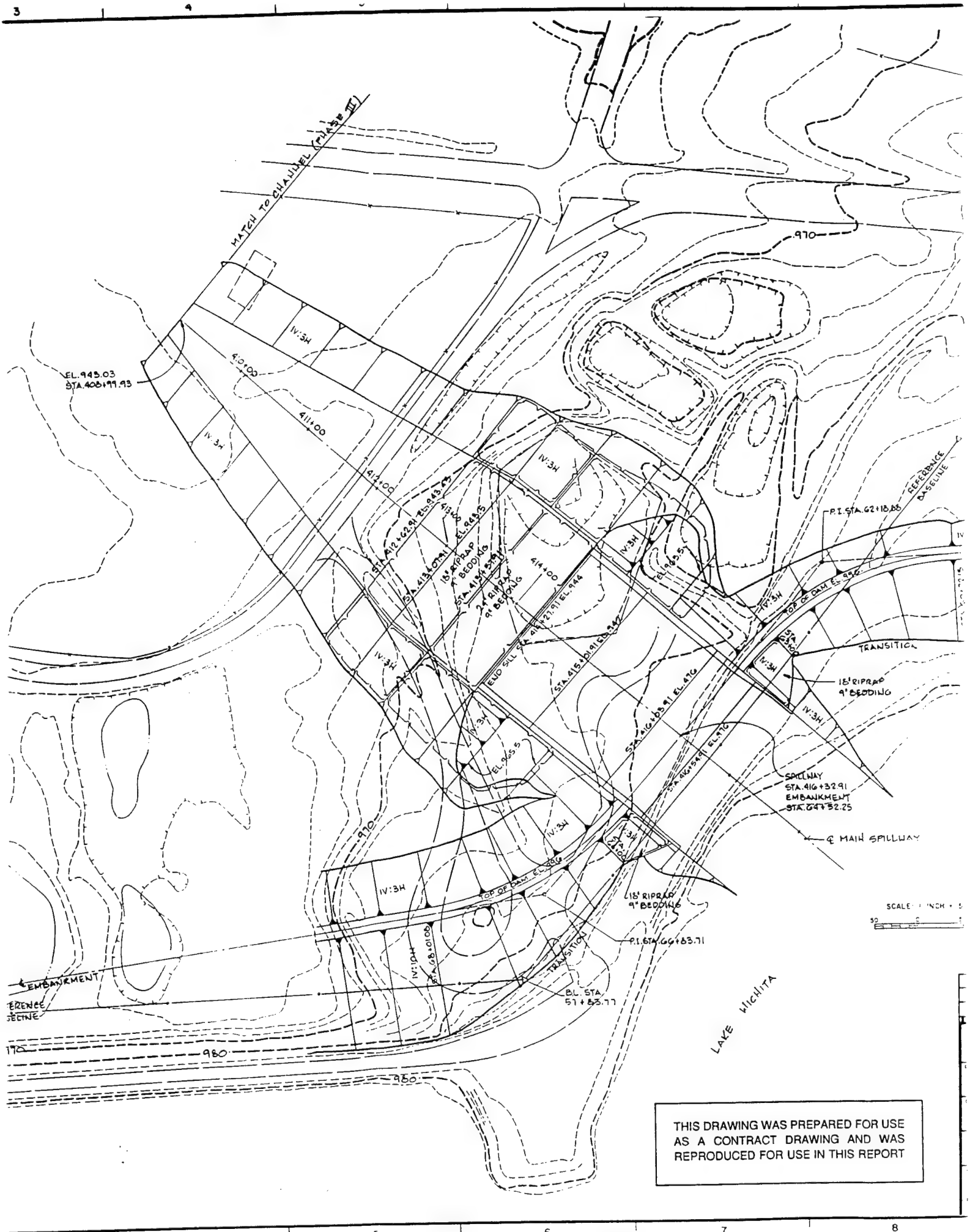

MATCH TO CHANNEL EXCAVATION (PHASE-III)
TRANSITION SLOPE (TYP.)
¢ EMBANKMENT
REFERENCE BASELINE
¢ EMBANKMENT
REFERENCE BASELINE
¢ MAIN SPILLWAY
CUTOFF EXCAVATION
LAKE WICHITA
980
970
SCALE: 1 INCH = 50 FEET
50 0 50 100
THIS
AS
REP
U.S. ARMY ENG
CORPS OF
TULSA, O
DESIGNED BY
E. MARTINEZ
DRAWN BY
B. SMITH
REVIEWED BY
R. SANCHEZ
SUBMITTED BY
JACK W. HUSSEY
ENGINEER
4
5
6
7
8



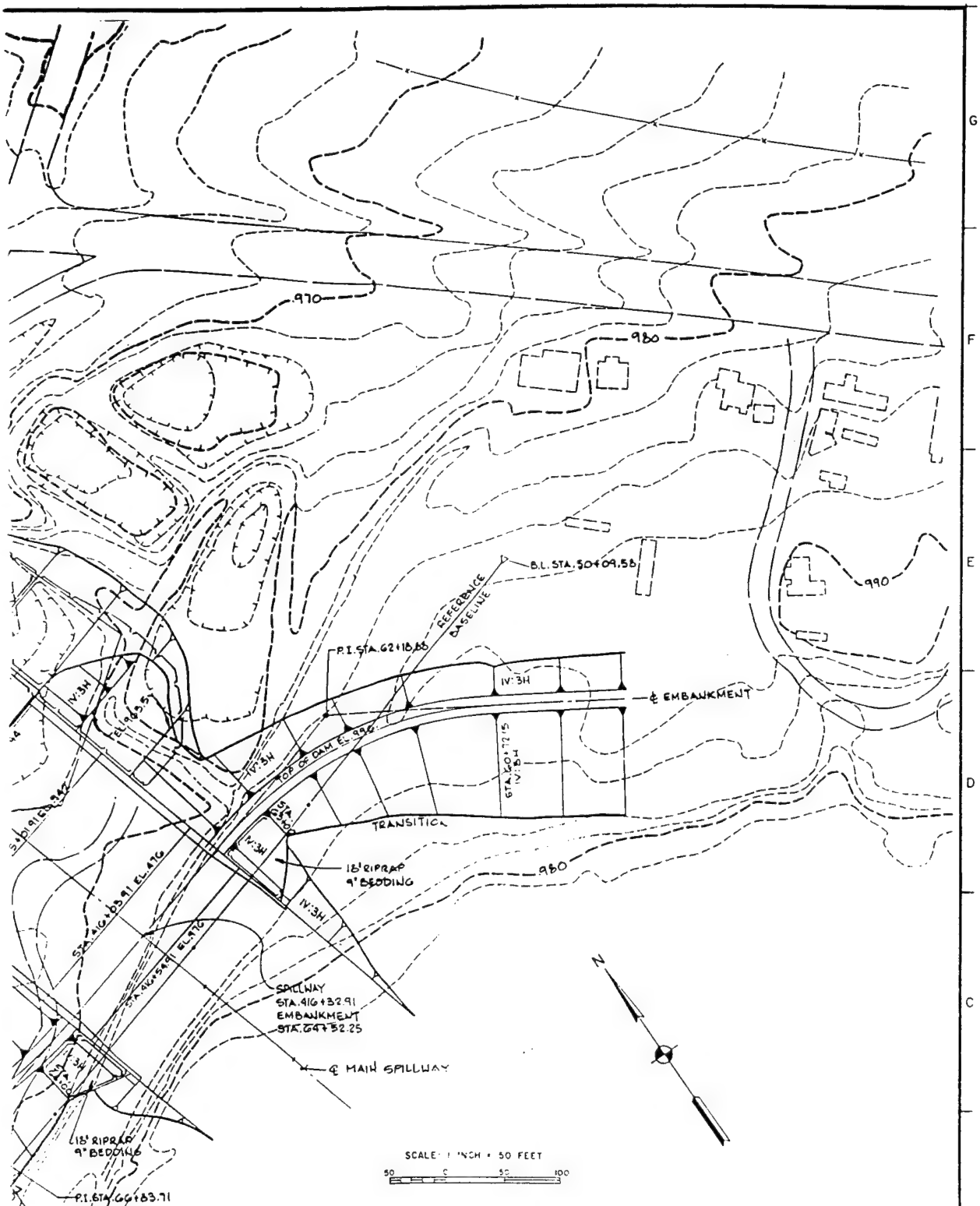
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: E. MARTINEZ	RED RIVER WATERSHED
DRAWN BY: B. SMITH	LAKE WICHITA
REVIEWED BY: R. SANCHEZ	HOLLIDAY CREEK, WICHITA FALLS, TEXAS
SUBMITTED BY: JACK W. HUSNEY, ENGINEER	LOCAL FLOOD PROTECTION PHASE III
SOL. NO.	EXCAVATION PLAN-SPILLWAY
CONTR. NO. DACW56-	DATED:
DRAWING NUMBER	SHEET NO. OF
SEQUENCE NO.	CONTR. NO.


MATCH TO CHANNEL (PHASE I)
1V:3H
410+00
411+00
1V:3H
EL. 993.03
STA. 408+99.93
P.I. STA. 74 + 87.02
℄ EMBANKMENT
REFERENCE BASELINE
970
980
G
F
E
D
C
B
A
1
2
3
4

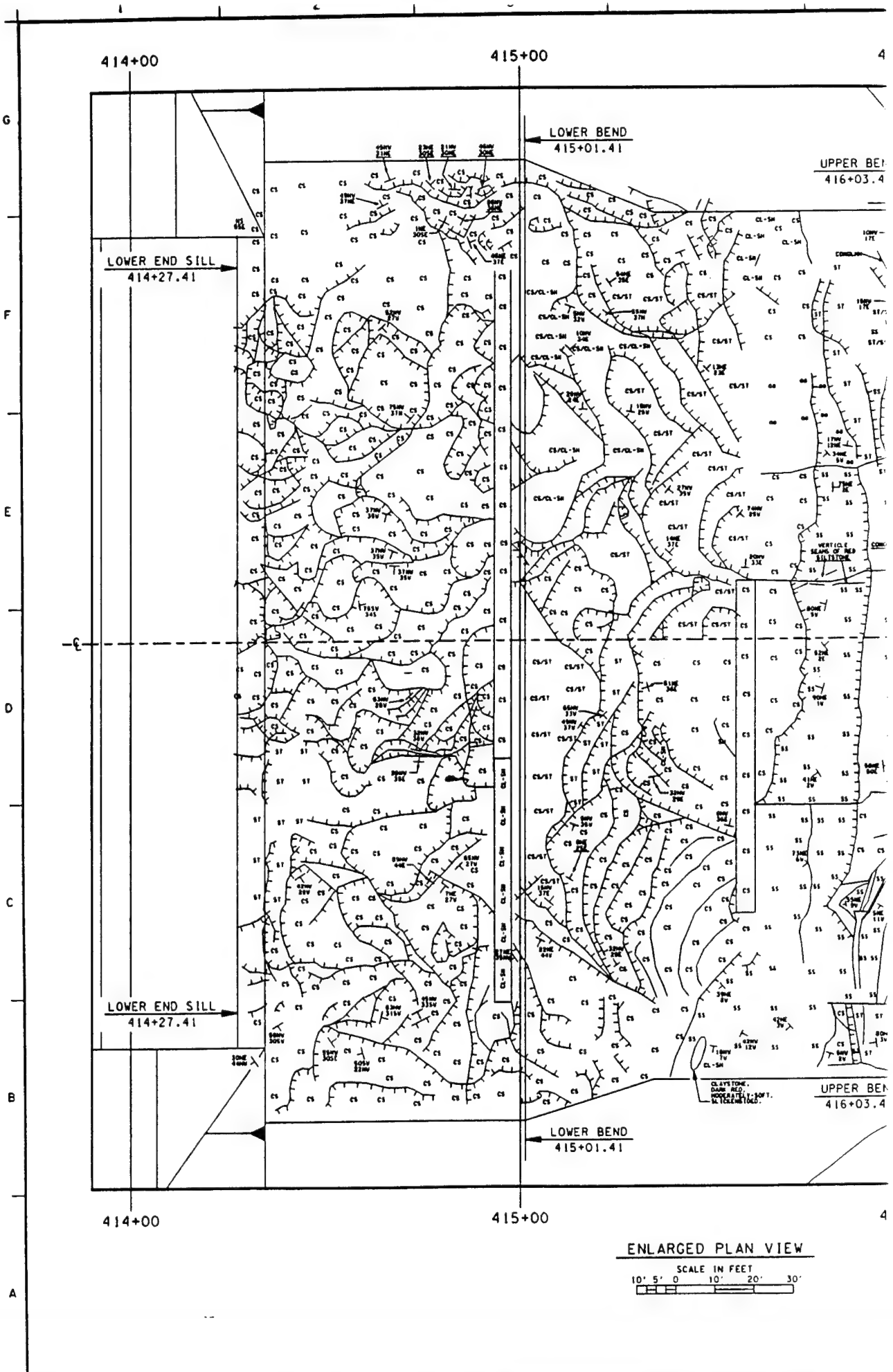


THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT



THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

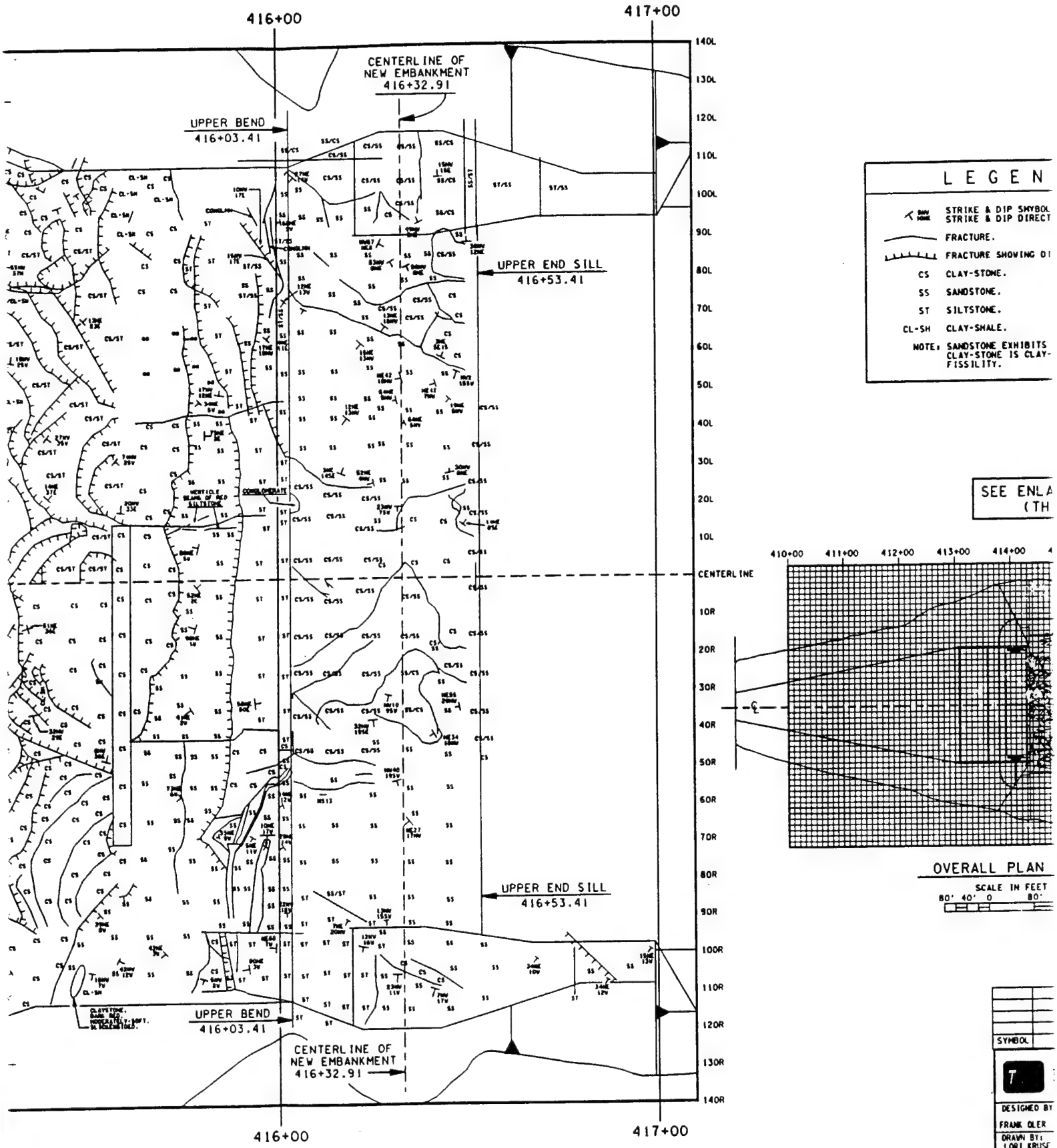
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: E. MARTINEZ	RED RIVER WATERSHED
DRAWN BY: M. BLANTON	LAKE WICHITA
REVIEWED BY: S. ARMSTRONG	HOLLIDAY CREEK, WICHITA FALLS, TEXAS
	LOCAL FLOOD PROTECTION PHASE III
	GRADING PLAN - SPILLWAY
SUBMITTED BY: JACK W. HUSSEY	SOL. NO. / DATED:
ENGINEER:	CONTR. NO. DACW56- / SEQUENCE NO.
	DRAWING NUMBER / SHEET NO. OF



ENLARGED PLAN VIEW

SCALE IN FEET

10' 5' 0 10' 20' 30'



ENLARGED PLAN VIEW

SCALE IN FEET
10' 5' 0 10' 20' 30'

LEGEN

- STRIKE & DIP SMYBOL / STRIKE & DIP DIRECT
- FRACTURE.
- FRACTURE SHOWING DI
- CS CLAY-STONE.
- SS SANDSTONE.
- ST SILTSTONE.
- CL-SH CLAY-SHALE.
- NOTE: SANDSTONE EXHIBITS CLAY-STONE IS CLAY-FISSILITY.

SEE ENLA (TH

OVERALL PLAN

SCALE IN FEET
80' 40' 0 80'

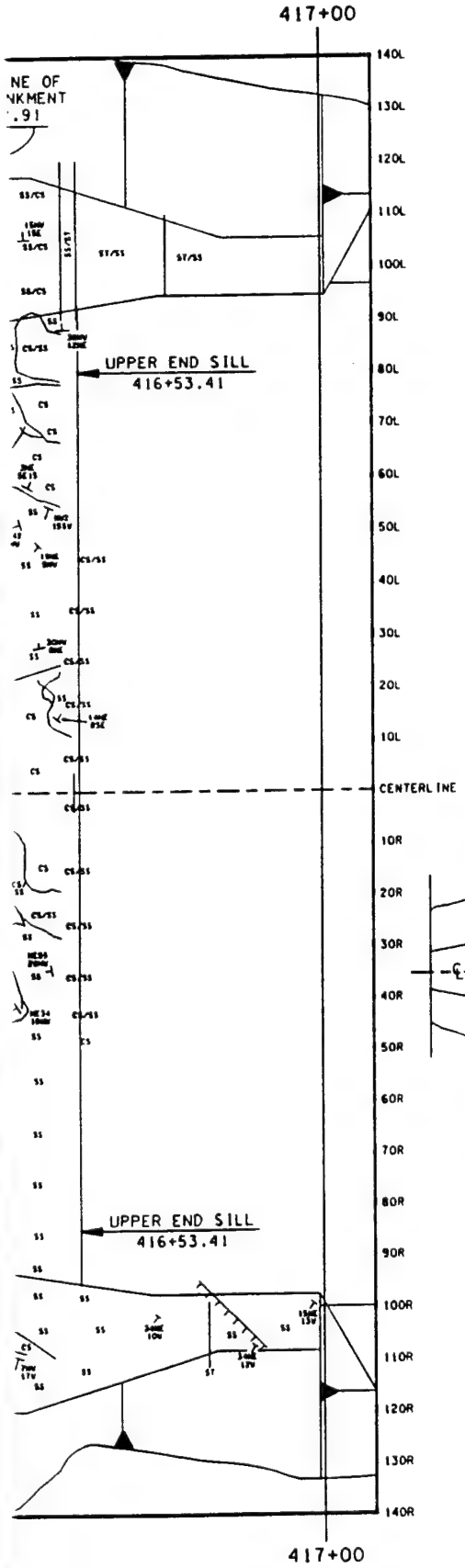
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

SYMBOL

DESIGNED BY
FRANK OLER
DRAWN BY: LORI KRUSE R.B. PETER
REVIEWED BY
RON BARKER
SUBMITTED B
CHIEF, GEOT
PLOT SCALE: AS SHOWN
DESIGN FILE: DAMCRACK.DGN
PLOT DATE: SEPTEMBER 19

4 5 6 7 8

(2)

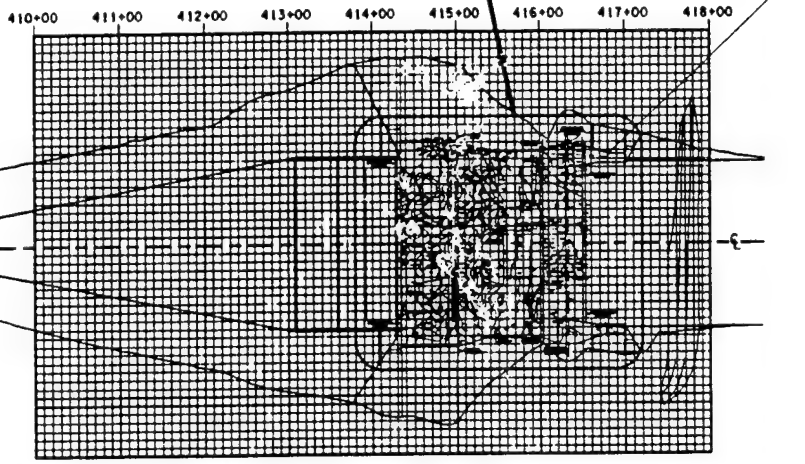


LEGEND

	STRIKE & DIP SMYBOL WITH STRIKE & DIP DIRECTION.
	FRACTURE.
	FRACTURE SHOWING DIF DIRECTION.
CS	CLAY-STONE.
SS	SANDSTONE.
ST	SILTSTONE.
CL-SH	CLAY-SHALE.

NOTE: SANDSTONE EXHIBITS CROSS-BEDDING. CLAY-STONE IS CLAY-SHALE WITHOUT FISSILITY.

SEE ENLARGED PLAN VIEW (THIS SHEET).



OVERALL PLAN VIEW

SCALE IN FEET
80' 40' 0 80' 160'

N

SYMBOL	DESCRIPTION	DATE	APPR

Tulsa District
Tulsa, Oklahoma

US Army Corps of Engineers

DESIGNED BY:
FRANK OLER

DRAWN BY:
LORI KRUSE
R.B. PETERSON

REVIEWED BY:
RON BARKER

SUBMITTED BY:

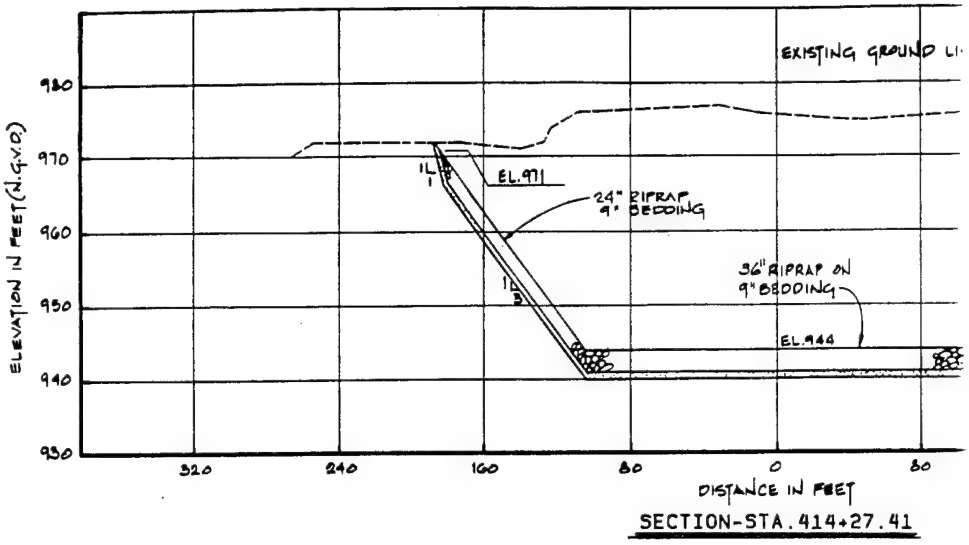
CHIEF, GEOTECH BRANCH

RED RIVER WATERSHED
LAKE WICHITA
HOLLIDAY CREEK, WICHITA FALLS, TEXAS

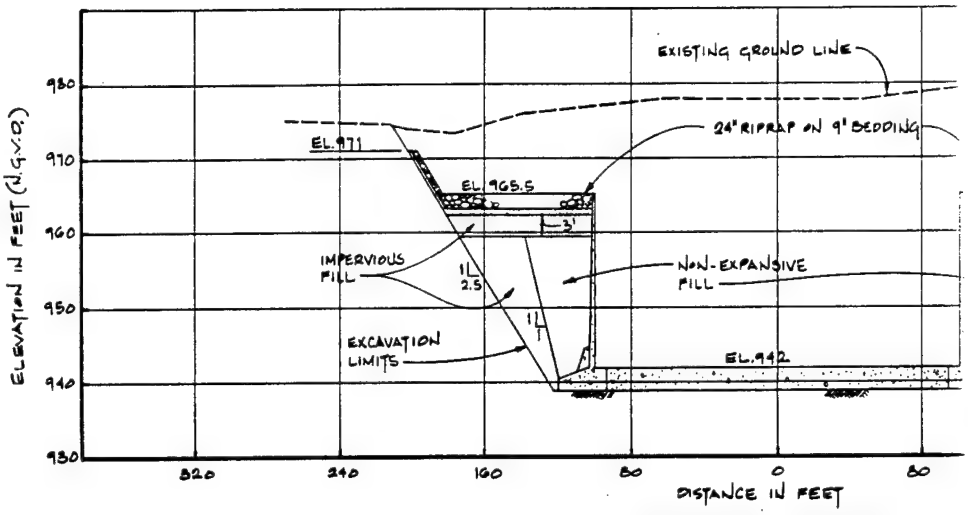
SPILLWAY INSPECTION
FOUNDATION MAPPING

PLOT SCALE: AS SHOWN	DL's, CODE:	CONTRACT DATE:	SHEET REFERENCE NUMBER
DESIGN FILE: DAMCRACK.DGN		INVITATION NO. DACA56- -B-	
PLOT DATE: SEPTEMBER 1996	SHEET OF	CONTRACT NO. DACA56- -C-	

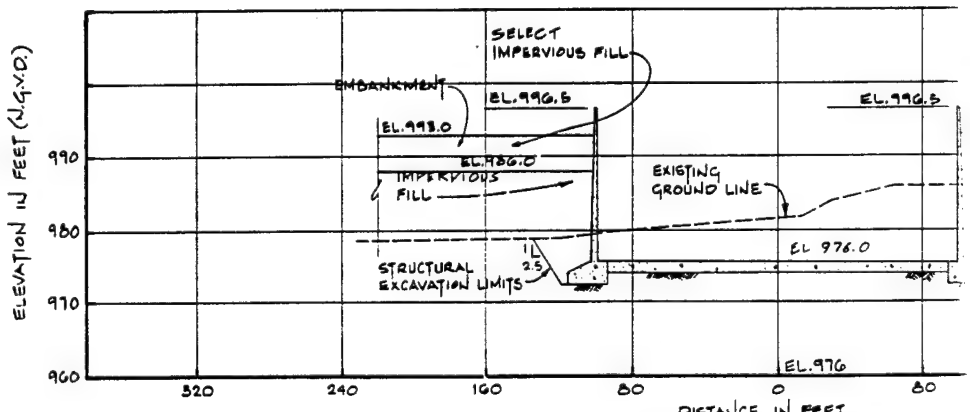
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT



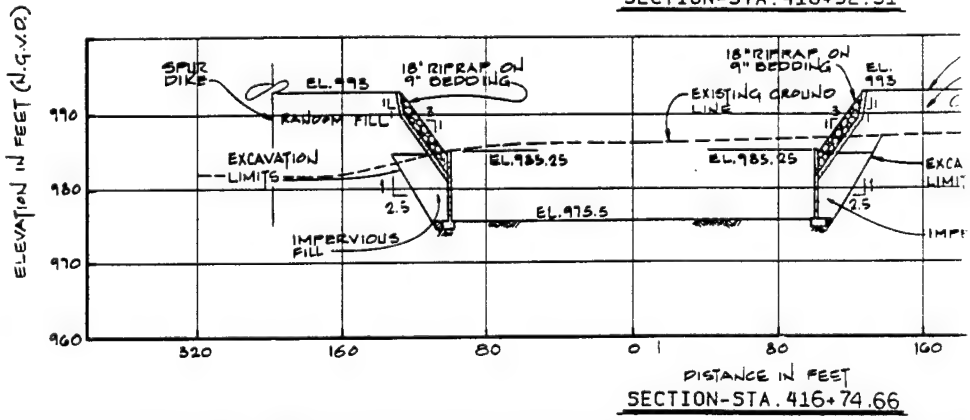
SECTION-STA. 414+27.41



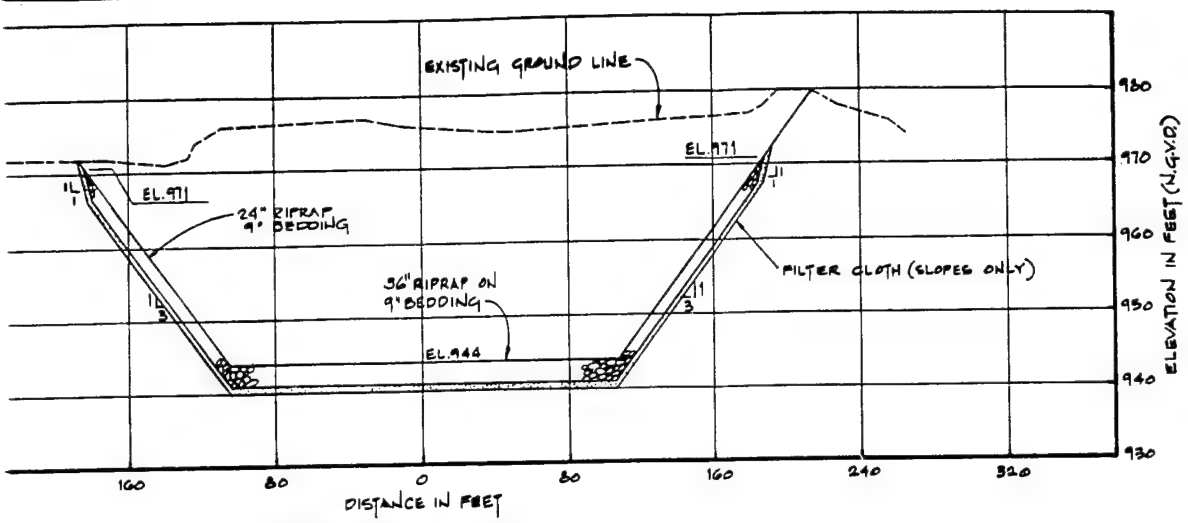
SECTION-STA. 414+95.08



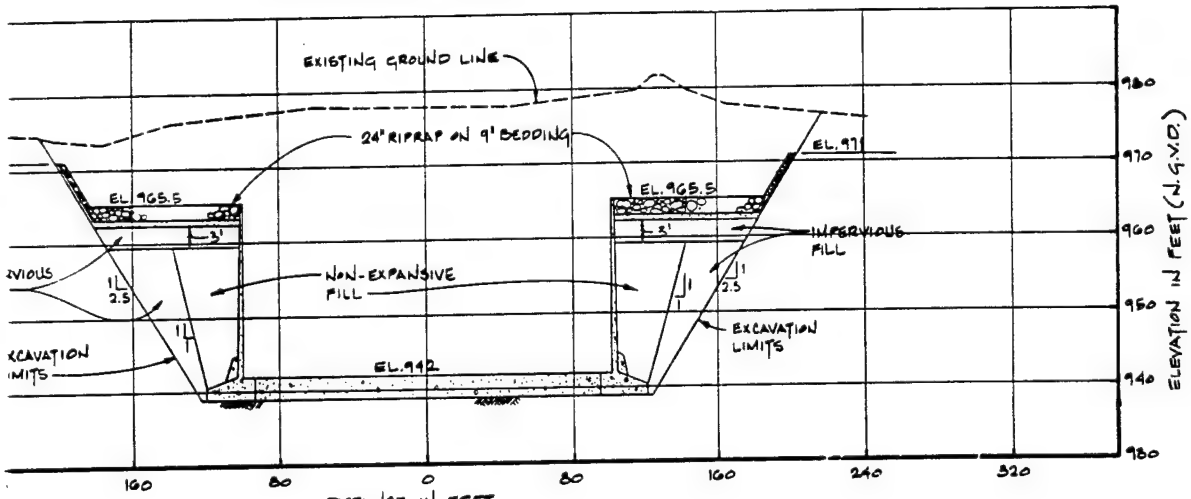
SECTION-STA. 416+32.91



SECTION-STA. 416+74.66



SECTION-STA. 414+27.41



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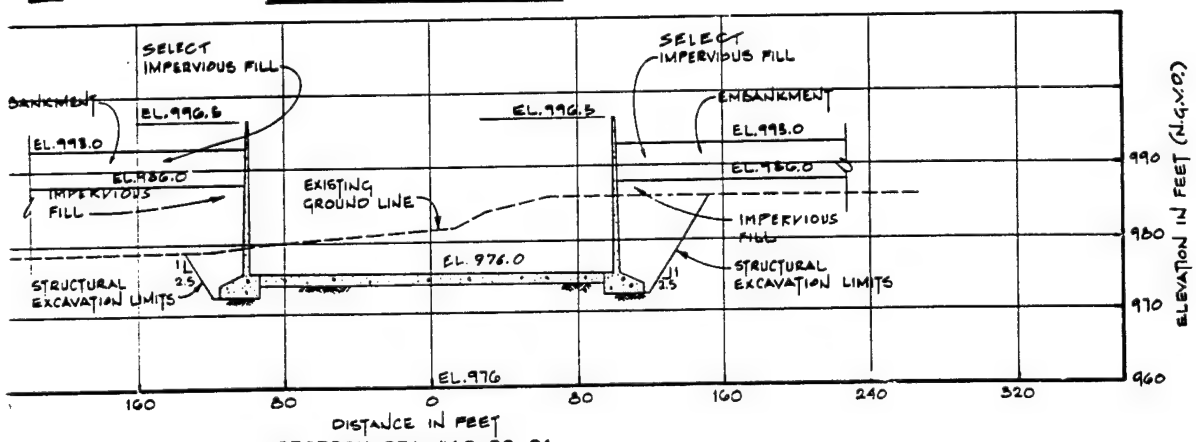
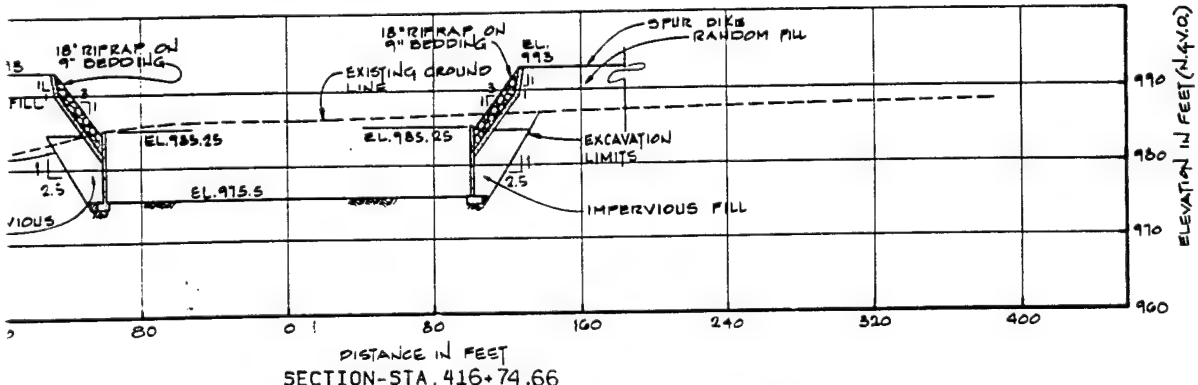
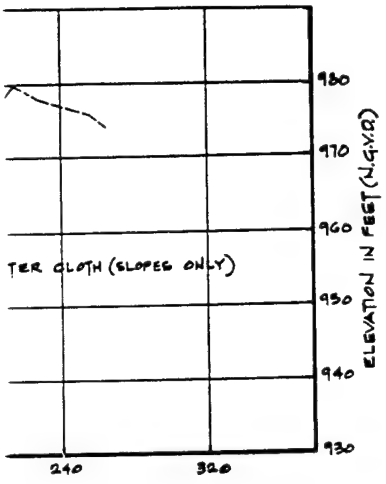
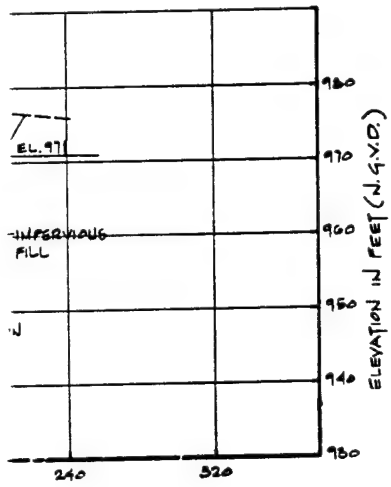


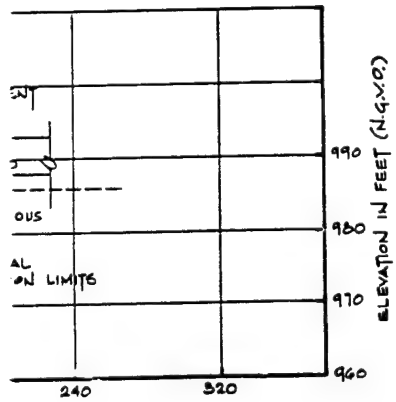
SECTION-STA. 416+32.91

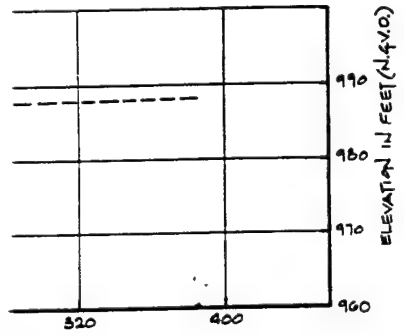


SECTION-STA. 416+74.66









MAIN SPILLWAY

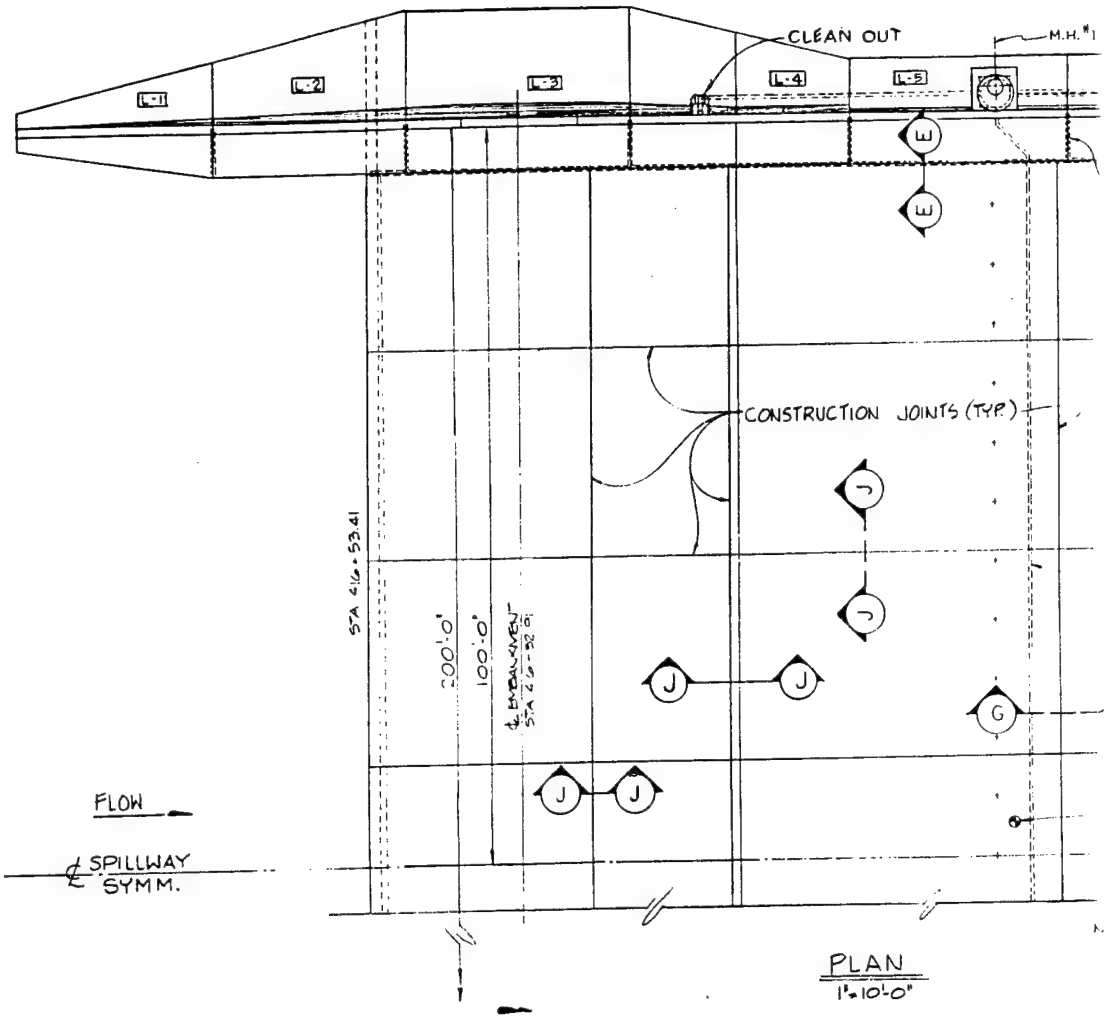
NOTES:

1. PLACE NON EXPANSIVE FILL BEHIND THE WALLS EXCEPT WHERE THE SPILLWAY PASSES THROUGH THE EMBANKMENT IMPERVIOUS CORE.

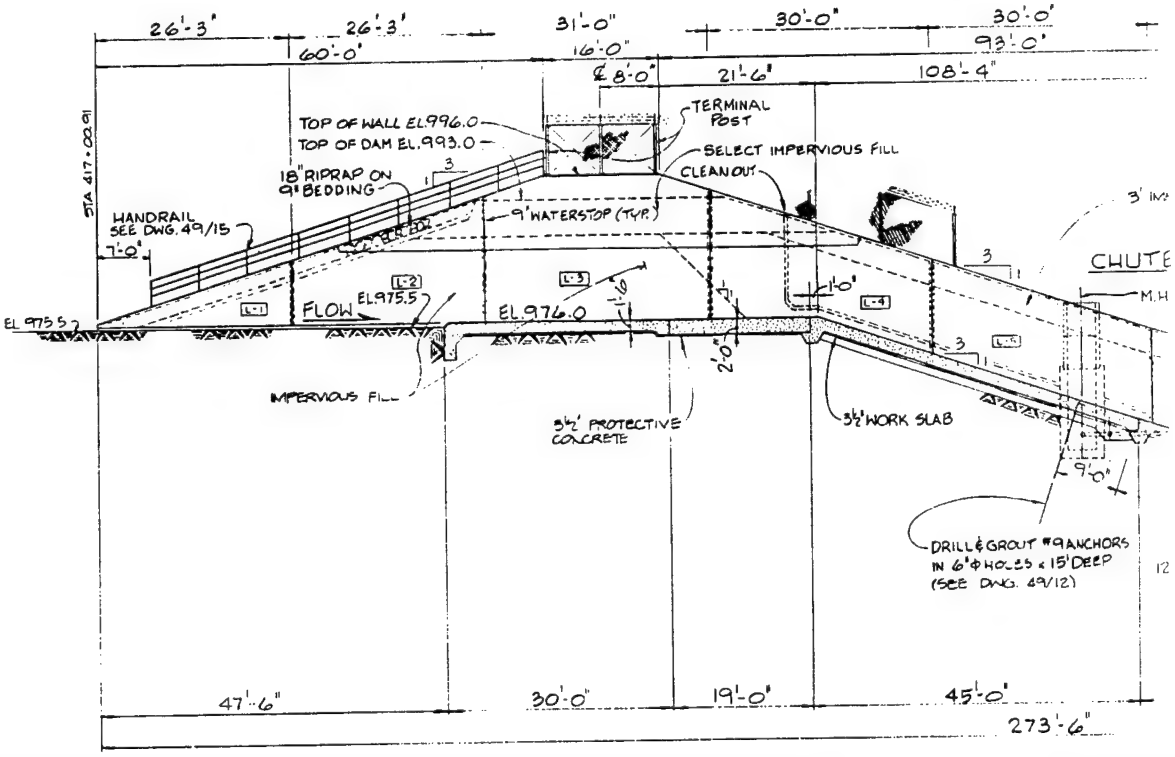
THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

REVISION NO.	INITIALS	DATE	DESCRIPTION OF REVISION	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA			U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: E. MARTINEZ	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III			
DRAWN BY: M. BLANTON				
REVIEWED BY: R. SANCHEZ	SPILLWAY SECTIONS			
SUBMITTED BY: JACK W. HUSSEY ENGINEER:	SOL. NO.	DATED:		
	CONTR. NO. DACW56-		SEQUENCE NO.	CONTR NO
	DRAWING NUMBER	SHEET NO. 6 OF		

PLATE 6

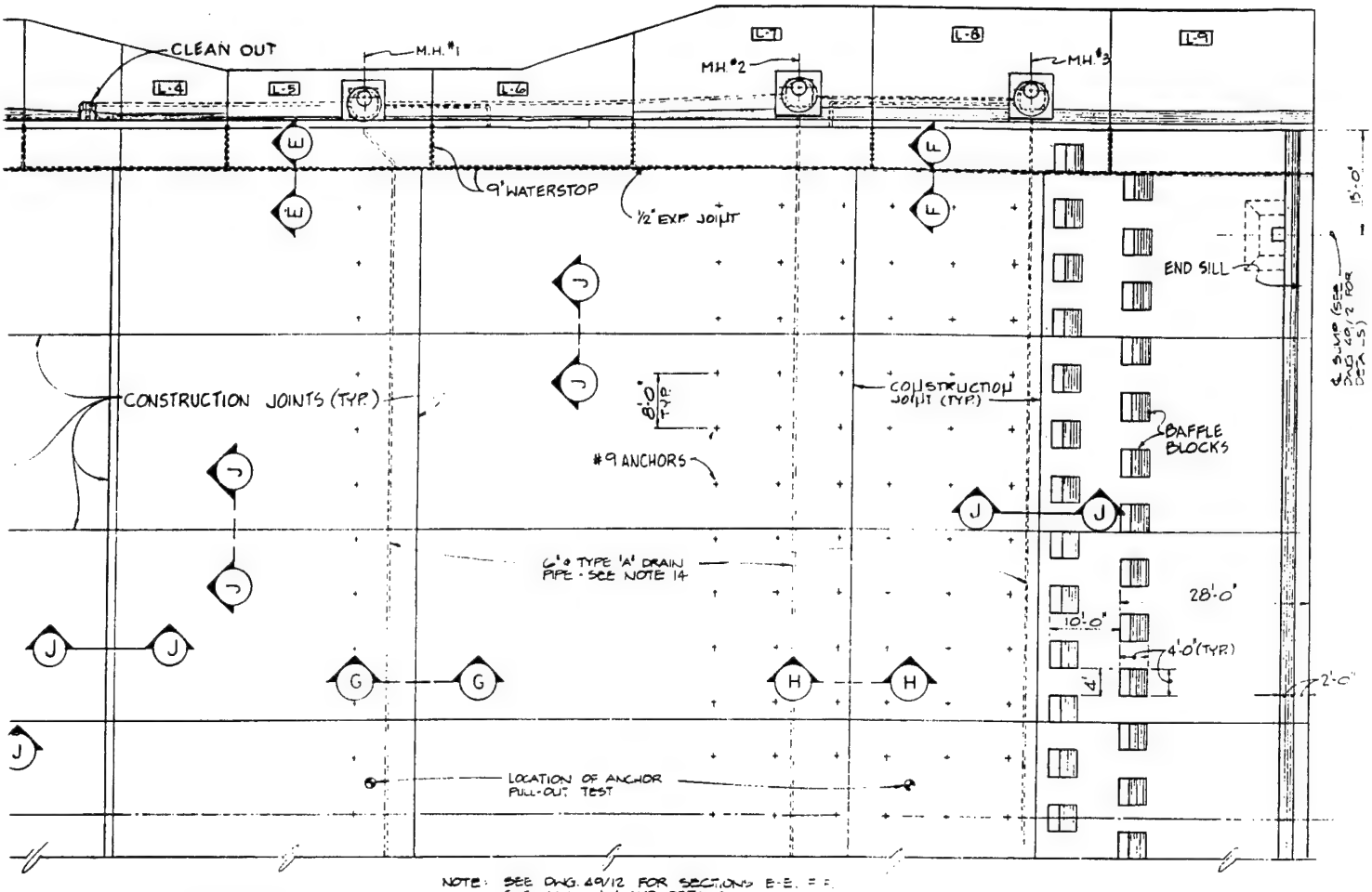


PLAN
1"=10'-0"

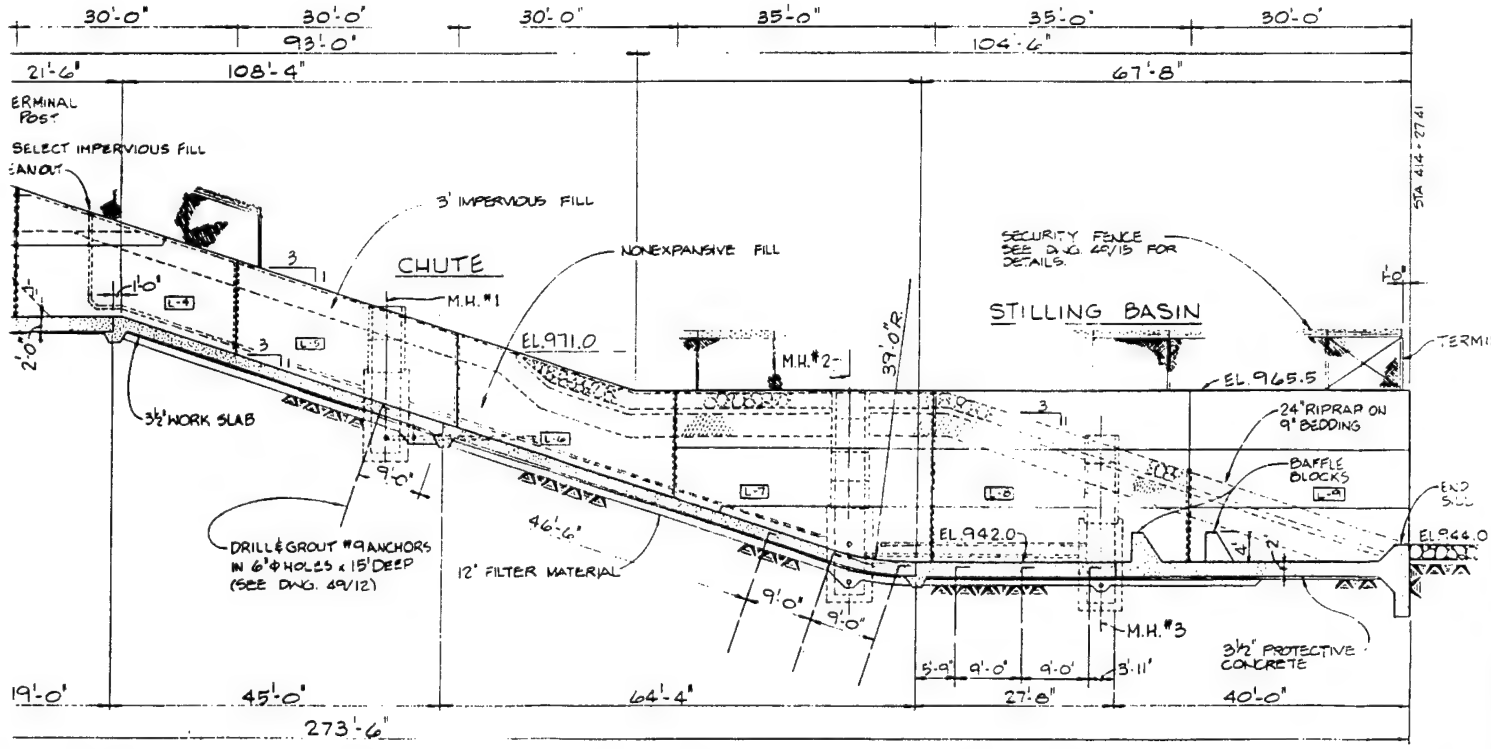


ELEVATION
1"=10'-0"

(1)

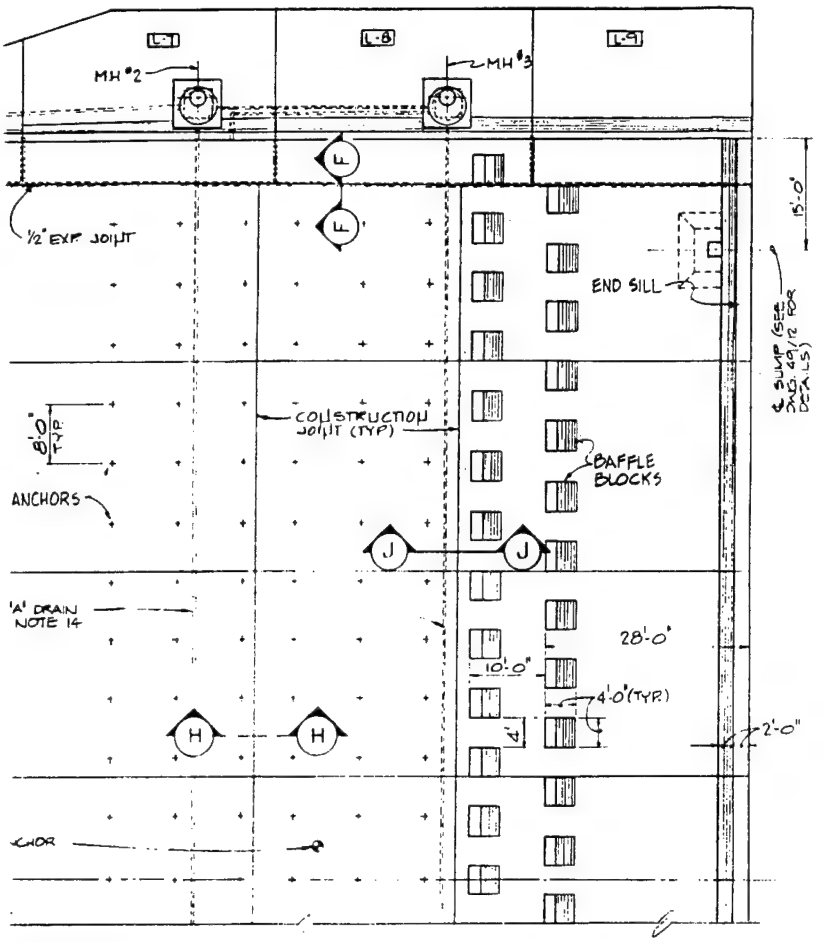


PLAN
1" = 10'-0"



ELEVATION
1" = 10'-0"

(2)

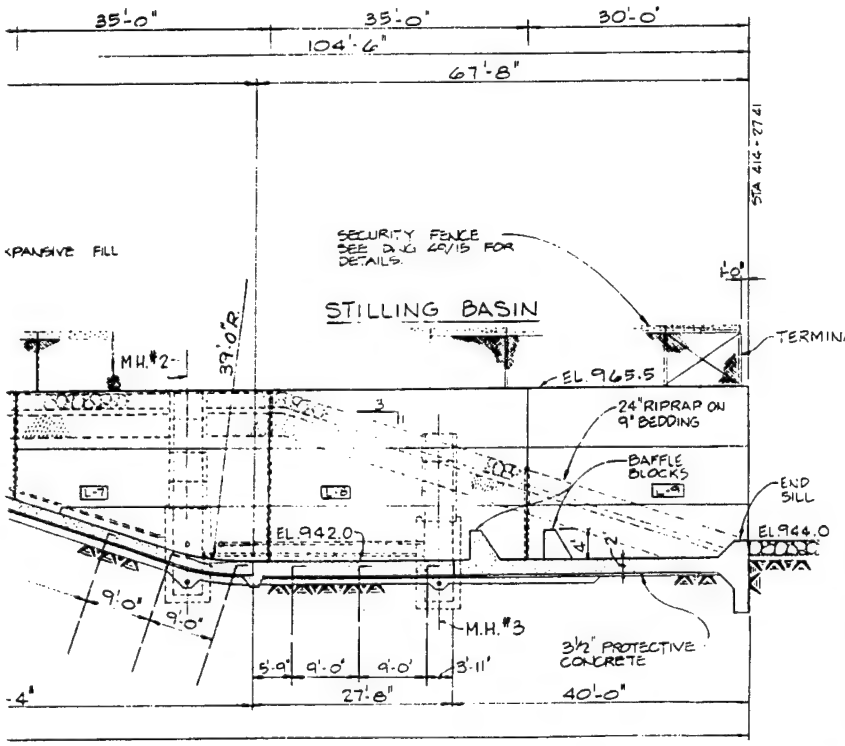


FOR SECTIONS E-E, F-F AND DETAILS.

GENERAL NOTES

1. CONCRETE SHALL HAVE THE FOLLOWING MINIMUM COMPRESSIVE STRENGTHS (f'_c):
   - PROTECTIVE CONCRETE/WORK SLAB, LEAN CONCRETE — f'_c = 2500. psi
   - CONCRETE FOR BAFFLES, END-SILLS, OUTLET WORKS STRUCTURES — f'_c = 4000. psi
   - ALL OTHER CONCRETE — f'_c = 3000. psi
2. UNLESS OTHERWISE NOTED, CONCRETE COVER OVER STEEL REINF. SHALL BE A MINIMUM OF 3.0 INCHES.
3. ALL EXPOSED CONCRETE EDGES SHALL BE CHAMFERED 3/4 INCHES, EXCEPT AS NOTED.
4. ALL CONCRETE SURFACES SHALL BE FINISHED IN ACCORDANCE WITH THE CONTRACT SPECIFICATIONS. ALL EXPOSED SURFACES SHALL HAVE A CLASS "B" FINISH, EXCEPT AS NOTED, AND CLASS "B" FINISH SHALL EXTEND ONE FOOT BELOW BACKFILL OR RIPRAP. CONCRETE SURFACES ONE FOOT BELOW BACKFILL OR RIPRAP AND FORMED CONTRACTION JOINTS SHALL HAVE A CLASS "D" FINISH.
5. ALL CONTRACTION AND CONSTRUCTION (LIFT) JOINTS IN EXPOSED FORMED SURFACES SHALL BE CHAMFERED 3/4 INCHES UNLESS NOTED OR SHOWN OTHERWISE.
6. CONTRACTION JOINTS (MONOLITH JOINTS) SHALL PREVENT BOND OF CONCRETE ACROSS THE JOINT. BOND BREAKING MATERIAL SHALL BE MEMBRANE CURING COMPOUND OR BITUMINOUS PAINT. WATERSTOPS SHALL BE PROTECTED FROM THE BOND BREAKING MATERIAL.
7. ALL JOINTS IN THE SPILLWAY SLAB SHALL HAVE TOOLED EDGES WITH RADIUS AS SHOWN ON THE DRAWINGS. SEE DWG. 49/12.
8. REINFORCING STEEL SHALL CONFORM TO THE REQUIREMENTS OF ASTM-A-615, A-616 OR A-617, GRADE 60.
9. ADDITIONAL LAP SPLICES FOR THE CONVENIENCE OF THE CONTRACTOR ARE PERMISSIBLE PROVIDED NO MORE THAN HALF OF THE BARS ARE SPLICED WITHIN ANY ONE LAP LENGTH. ALL ADDITIONAL SPLICES ARE AT THE CONTRACTOR'S EXPENSE.
10. ALL REINFORCING STEEL LAP AND EMBEDMENT LENGTHS, STANDARD HOOK DIMENSIONS AND SPLICE DETAILS SHALL BE IN ACCORDANCE WITH ACI 318-83, UNLESS OTHERWISE SHOWN OR NOTED. (SEE TABLE ON DWG. 49/15.)
11. DROP STRUCTURE WINGWALLS SHALL BE BACKFILLED UNIFORMLY ON BOTH SIDES SO THAT THE MAXIMUM DIFFERENTIAL FILL HEIGHT DOES NOT EXCEED FIVE (5) FEET.
12. FOR GRADATION OF RIPRAP, SEE SPECIFICATONS.
13. WATERSTOPS TO BE AS MANUFACTURED BY GREENSTREAK, INC., ST. LOUIS, MO. 63177; STYLE 734 AND 737, OR APPROVED EQUAL.
14. TYPE "A" DRAIN PIPE IS CORRUGATED POLYETHYLENE PIPE WITH SLOTTED PERFORATIONS AND A FILTER FABRIC COVERING, SUCH AS "SOCK" DRAIN MANUFACTURED BY ADVANCED DRAINAGE SYSTEMS, INC. OF COLOMBUS, OHIO; OR HANCAR, INC. OF YOAKUM, TEXAS.
15. TO SECURE A VERTICAL OR NEAR VERTICAL CUT IN THE FOUNDATION MATERIALS, THE CONTRACTOR MAY USE ANY METHOD OF EXCAVATION APPROVED BY THE CONTRACTING OFFICER. NO PAYMENT WILL BE MADE FOR OVERBREAKAGE BEYOND THE LIMITS OF EXCAVATION SHOWN ON THE DRAWINGS. WHERE CONCRETE IS PLACED AGAINST THE FACE OF THE EXCAVATION, THE CONTRACTOR WILL BE REQUIRED TO REPLACE ANY OVERBREAKAGE WITH CONCRETE, AT HIS EXPENSE.
16. THE SECTIONS OF THE SPILLWAY SLAB, AS DIVIDED BY THE INDICATED CONSTRUCTION JOINTS, SHALL BE PLACED IN AN ALTERNATING FASHION FORMING A CHECKERBOARD PATTERN. THERE SHALL BE A MINIMUM OF 72 HOURS BETWEEN PLACING ADJACENT SECTIONS. CLOSURE SECTIONS MEET TO THE RETAINING WALLS SHALL BE PLACED IN ALTERNATING FASHION AFTER COMPLETION OF THE WALL FOOTINGS.
17. THE CONTRACTOR MAY, AT HIS OPTION, USE CONTINUOUS LANE PAVING FOR THE CHUTE AND STILLING BASIN SLABS. THERE IS NO RESTRICTION ON THE WIDTH OF LANE USED. IF THIS OPTION IS SELECTED, THE LANES SHALL BE PLACED IN ALTERNATING FASHION WITH A MINIMUM TIME OF 72 HOURS BETWEEN PLACING ADJACENT LANES. CONSTRUCTION JOINTS ARE REQUIRED BETWEEN LANES AND WHENEVER CONCRETE PLACEMENT IS INTERRUPTED FOR A TIME SUFFICIENT TO CAUSE A COLD JOINT.

C.J. = CONSTRUCTION JOINT, M.H. = MANHOLE, D.S. = DOWNSTREAM, U.S. = UPSTREAM, E.W. = EACH WAY, E.F. = EACH FACE, T.F. = TOP FACE, B.F. = BOTTOM FACE, N.F. = NEAR FACE, F.F. = FAR FACE, T & B = TOP & BOTTOM, C.I. = CAST IRON



THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

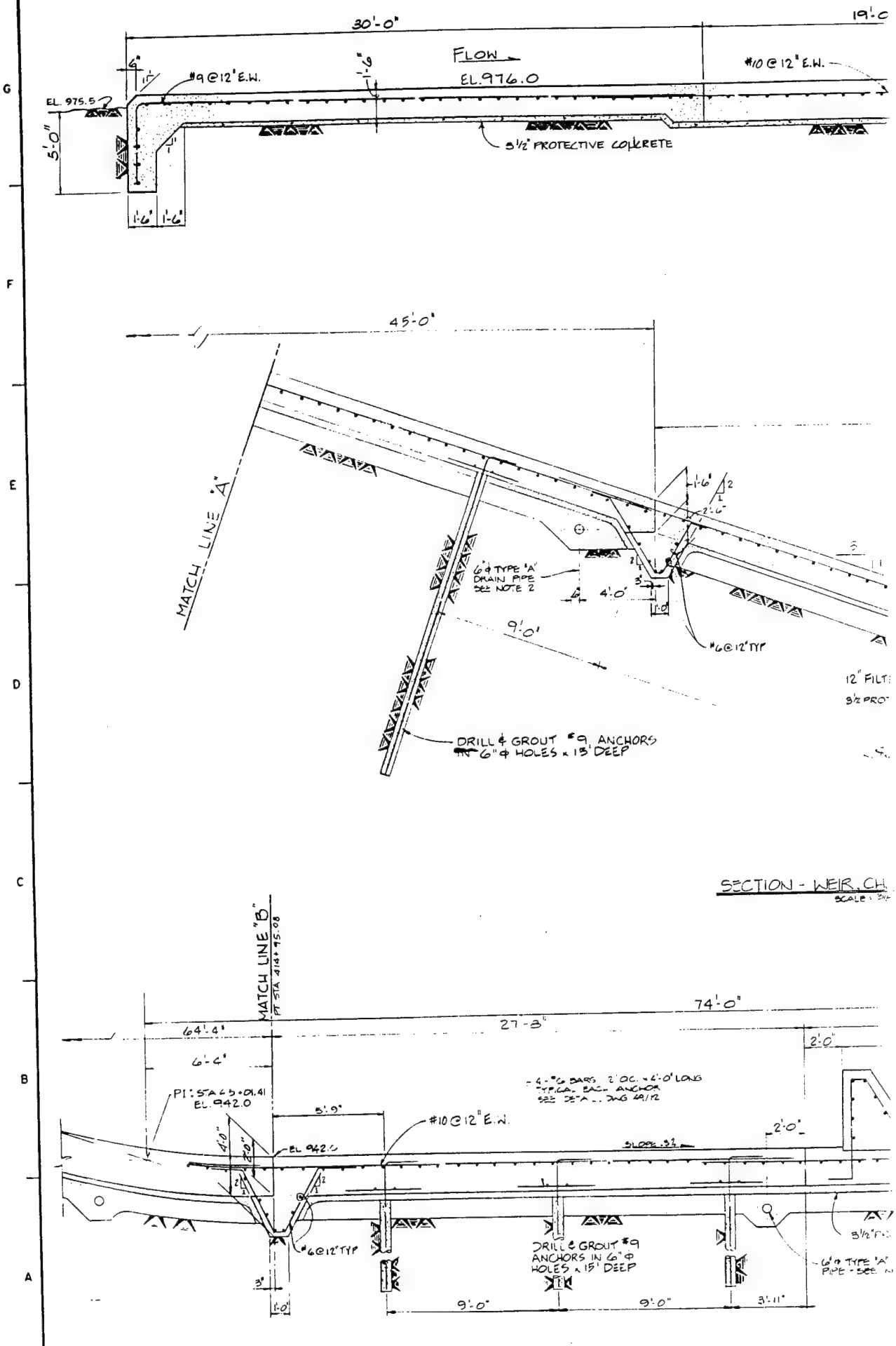
10' 5' 0' 10' 20'
1"=10'-0"

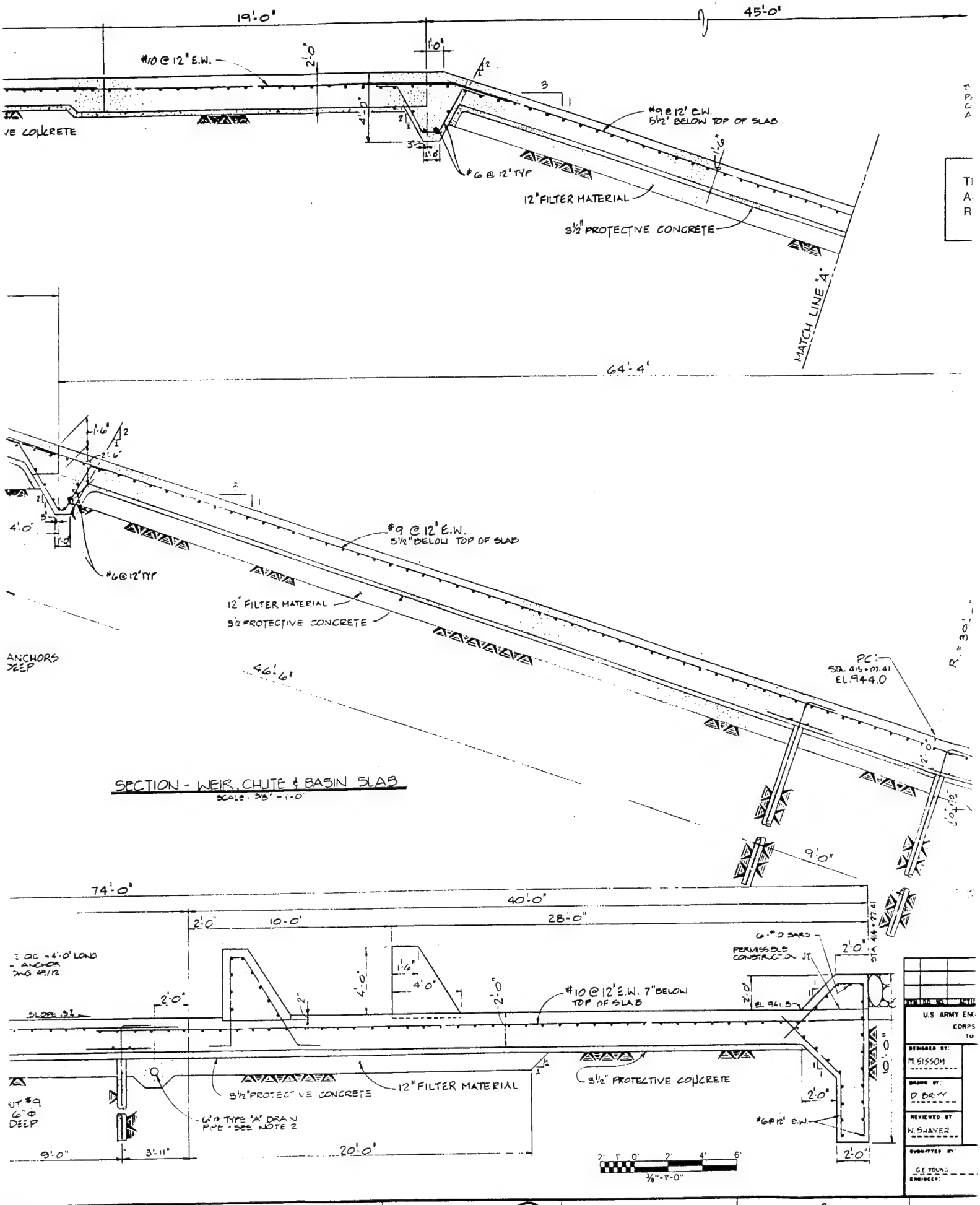
U.S. ARMY ENGINEER DISTRICT, TULSA CORPS OF ENGINEERS TULSA, OKLAHOMA	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: M SISSON	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION, PHASE III
DRAWN BY: D BRITT	MAIN SPILLWAY
REVIEWED BY: W SHAVER	PLAN, PROFILE AND GENERAL NOTES
SUBMITTED BY: G E YOUNG, ENGINEER	SOL. NO. DACW56-92-B-0032 DATED: CONTR. NO. DACW56- DRAWING NUMBER BE360-C3-49/1 SHEET NO. OF SEQUENCE NO.

6 7 8

(3)

PLATE 7


30'-0"
19'-0
FLOW
EL. 976.0
#9 @ 12" E.W.
#10 @ 12" E.W.
EL. 975.5
5'-0"
5½" PROTECTIVE CONCRETE
1'-6"
1'-6"
45'-0"
MATCH LINE "A"
6" ϕ TYPE "A" DRAIN PIPE SEE NOTE 2
4'-0"
9'-0"
#6 @ 12" TYP
DRILL & GROUT #9 ANCHORS IN 6" ϕ HOLES x 15' DEEP
12" FILT
3½ PRO
SECTION - WEIR, CH
SCALE
MATCH LINE "B"
PT STA 414+95.08
74'-0"
64'-4"
27'-8"
6'-4"
2'-0"
4-#6 BARS, 2' OC. x 4'-0" LONG TYPICAL BAC. ANCHOR SEE DET A., DWG 49/12
PI: STA 415+01.41
EL. 942.0
5'-9"
#10 @ 12" E.W.
4'-0"
2'-0"
EL 942.0
SLOPE .5%
#6 @ 12" TYP
DRILL & GROUT #9 ANCHORS IN 6" ϕ HOLES x 15' DEEP
3'
1'-0"
9'-0"
9'-0"
3'-11"
6" ϕ TYPE "A" PIPE - SEE N
1
2
3
4
A
B
C
D
E
F
G

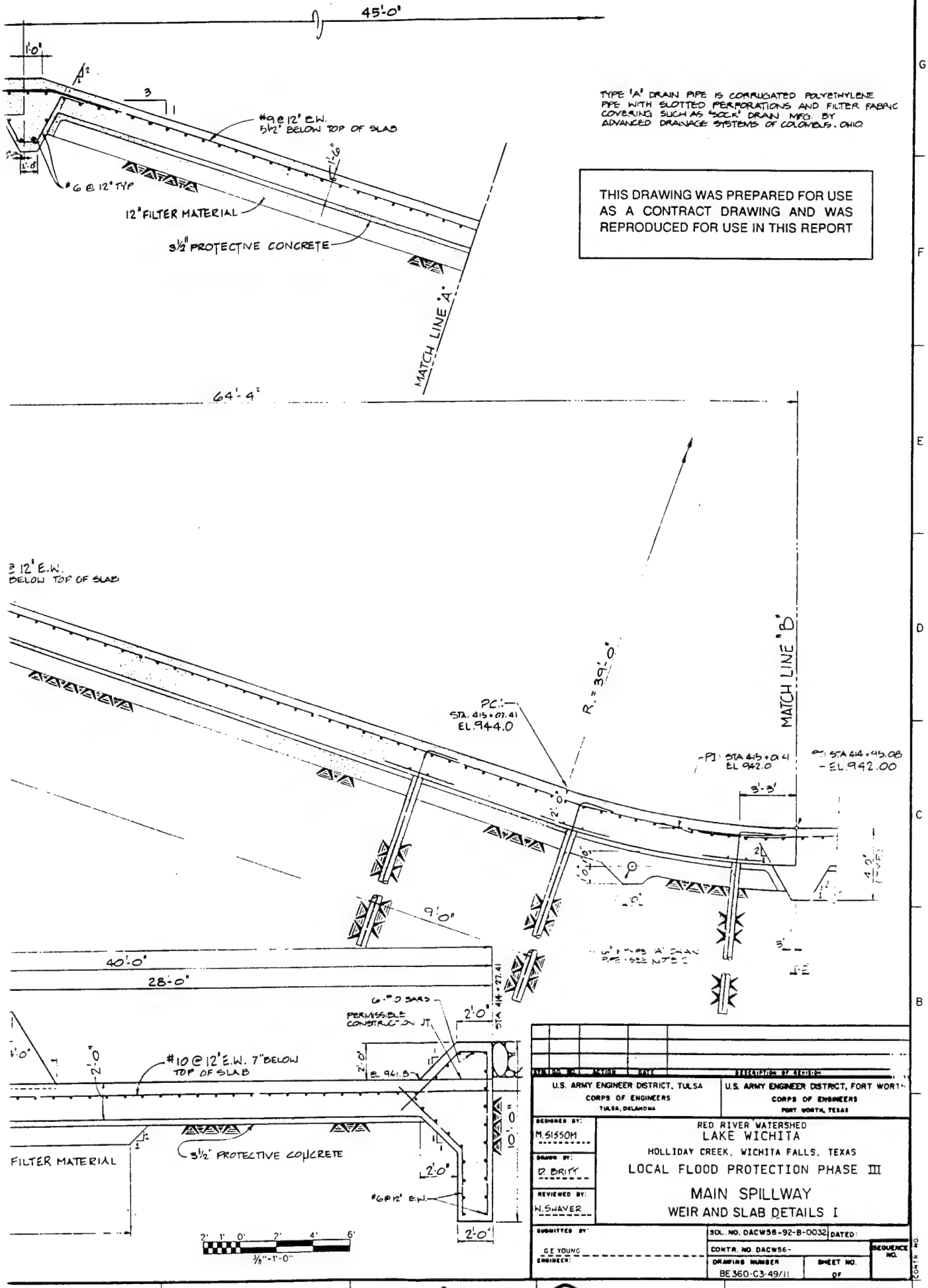


SECTION - WEIR, CHUTE & BASIN SLAB

SCALE: 3/8" = 1'-0

4 5 6 7 8

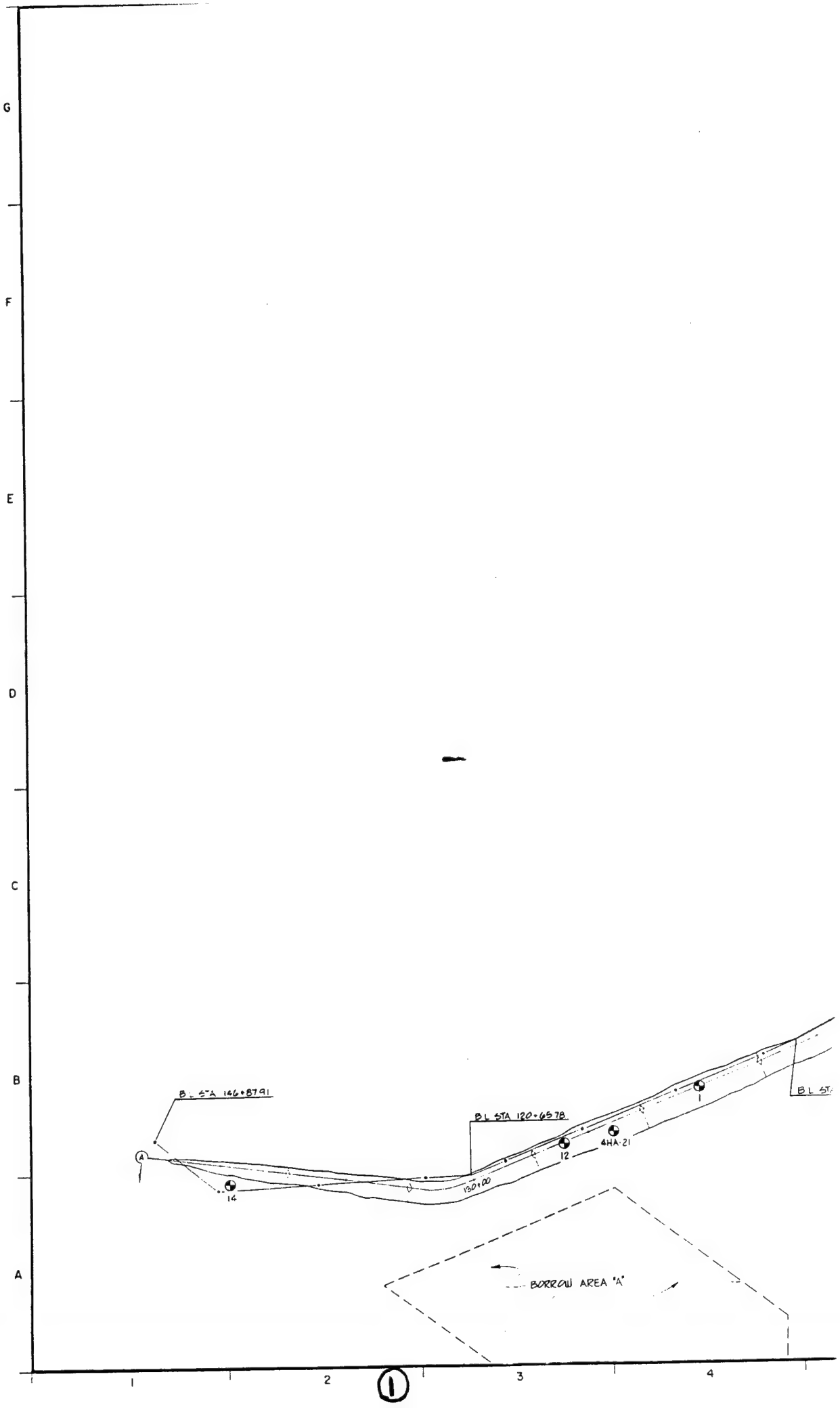
(2)

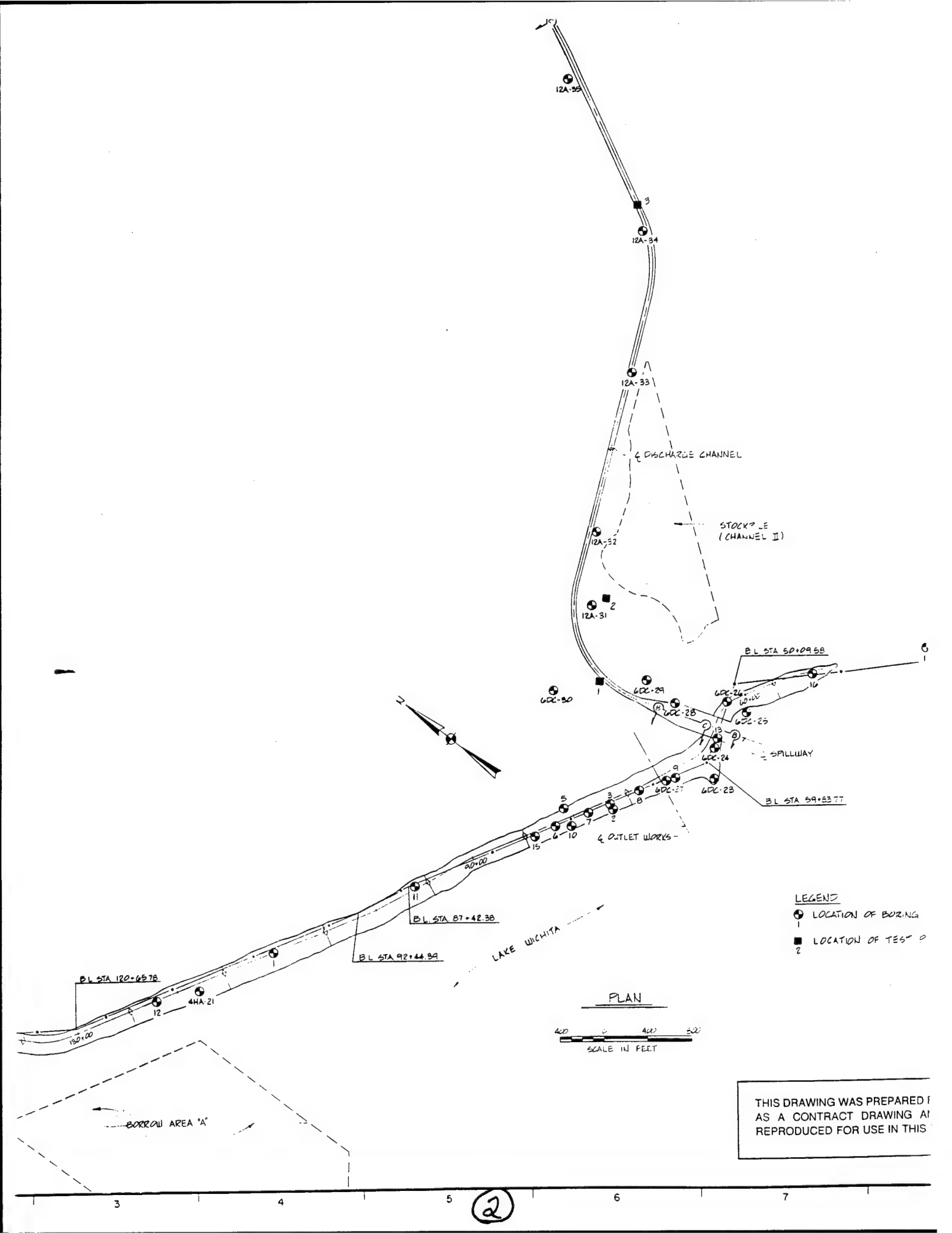


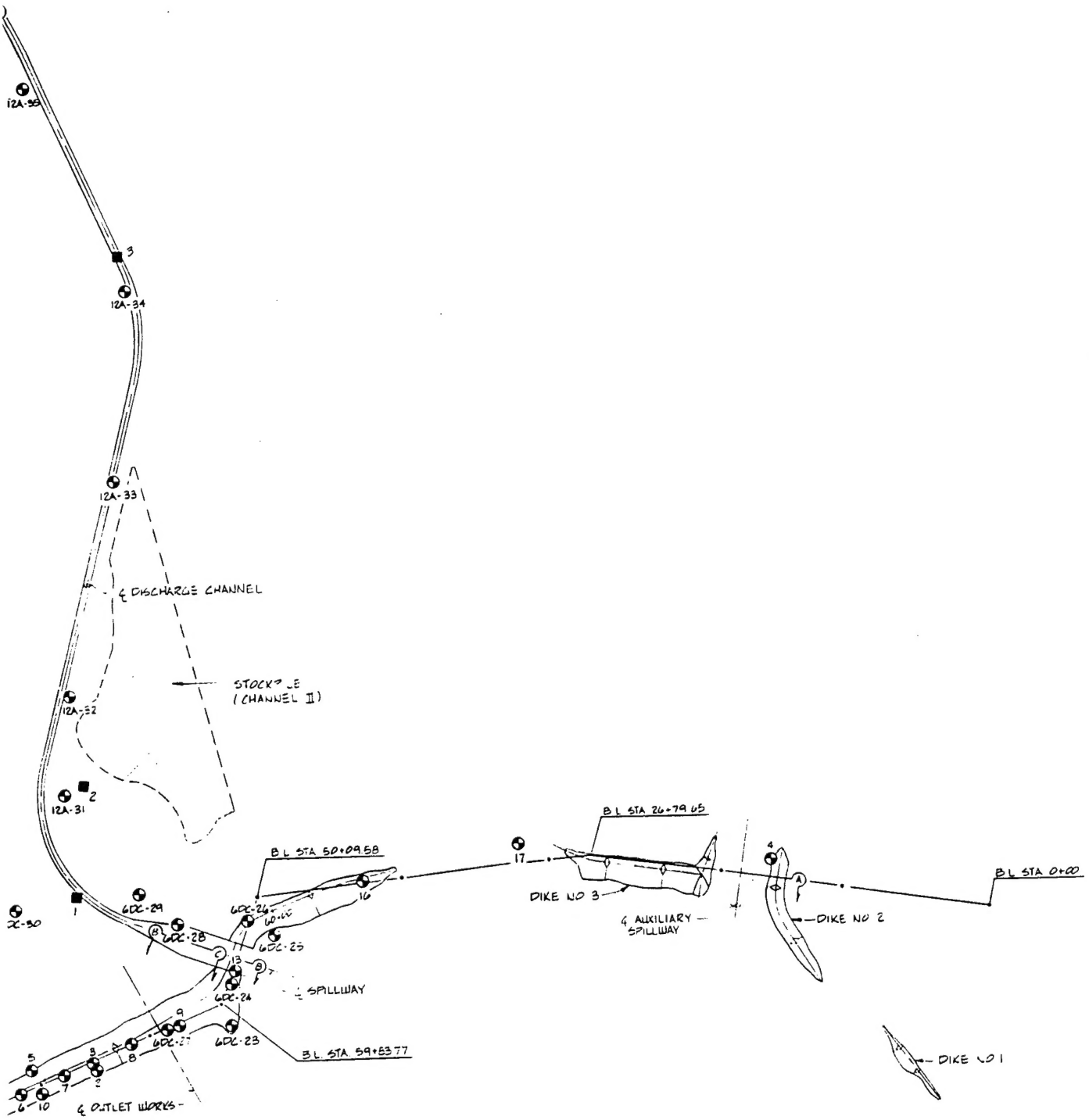
TYPE 'A' DRAIN PIPE IS CORRUGATED POLYETHYLENE PIPE WITH SLOTTED PERFORATIONS AND FILTER FABRIC COVERING SUCH AS 'SOCK' DRAIN MFG. BY ADVANCED DRAINAGE SYSTEMS OF COLUMBUS, OHIO

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

U.S. ARMY ENGINEER DISTRICT, TULSA CORPS OF ENGINEERS TULSA, OKLAHOMA	U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS
DESIGNED BY: M. SISSOM	RED RIVER WATERSHED
DRAWN BY: D. BRITT	LAKE WICHITA
REVIEWED BY: W. SHAVER	HOLLIDAY CREEK, WICHITA FALLS, TEXAS
	LOCAL FLOOD PROTECTION PHASE III
	MAIN SPILLWAY
	WEIR AND SLAB DETAILS I
SUBMITTED BY: G.E. YOUNG ENGINEER:	SOL. NO. DACW56-92-B-0032 DATED:
	CONTR. NO. DACW56-
	DRAWING NUMBER BE360-C3-49/11
	SHEET NO. OF
	SEQUENCE NO.


G
F
E
D
C
B
A
1
2
3
4
B L STA 166+87.91
BL STA 120+65.78
BL ST.
A
14
130+00
12
4HA-21
1
BORROW AREA "A"


12A-35
12A-34
12A-33
12A-32
12A-31
℄ DISCHARGE CHANNEL
STOCKPILE (CHANNEL II)
BL STA 50+09.58
6DC-30
6DC-29
6DC-28
6DC-26
6DC-25
6DC-24
℄ SPILLWAY
6DC-27
6DC-23
BL STA 59+53.77
℄ OUTLET WORKS
BL STA 87+42.38
BL STA 92+44.89
LAKE WICHITA
BL STA 120+65.78
4HA-21
BORROW AREA "A"
LEGEND
LOCATION OF BORING
LOCATION OF TEST P
PLAN
SCALE IN FEET
THIS DRAWING WAS PREPARED F
AS A CONTRACT DRAWING AI
REPRODUCED FOR USE IN THIS



LEGEND

1 LOCATION OF BORING

2 LOCATION OF TEST PIT

PLAN

SCALE IN FEET

THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

REVISION NO.	REVISION	DATE	DESCRIPTION OF REVISION

U.S. ARMY ENGINEER DISTRICT, FORT WORTH
CORPS OF ENGINEERS
FORT WORTH, TEXAS

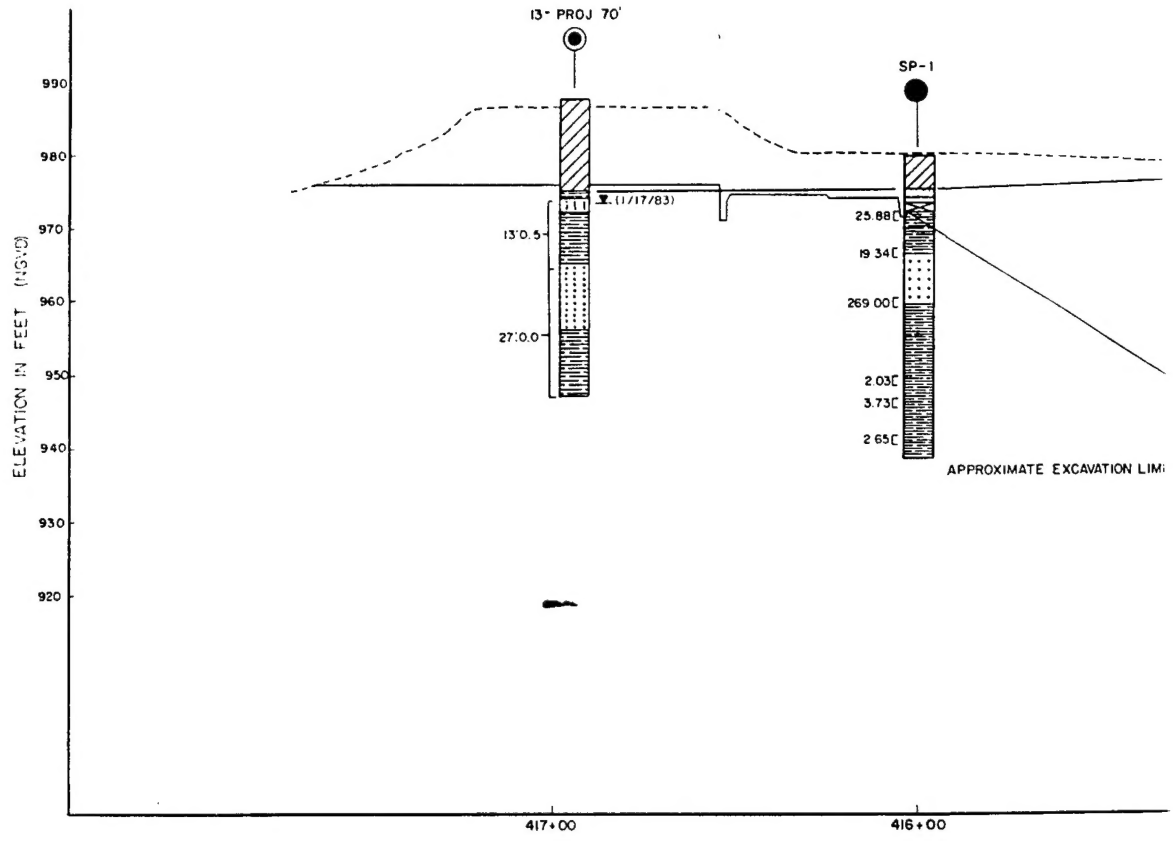
DESIGNED BY: A MARR, M KARBS
DRAWN BY: K MILLER
REVIEWED BY: R BEHM, A MARR
SUBMITTED BY: R BEHM
ENGINEER:

RED RIVER WATERSHED
LAKE WICHITA
HOLLIDAY CREEK WICHITA FALLS, TEXAS

LOCAL FLOOD PROTECTION PHASE III

PLAN OF INVESTIGATIONS

SOL. NO. | DATED:
CONTR NO
DRAWING NUMBER | SHEET NO OF
SEQUENCE NO.
CONTR NO.

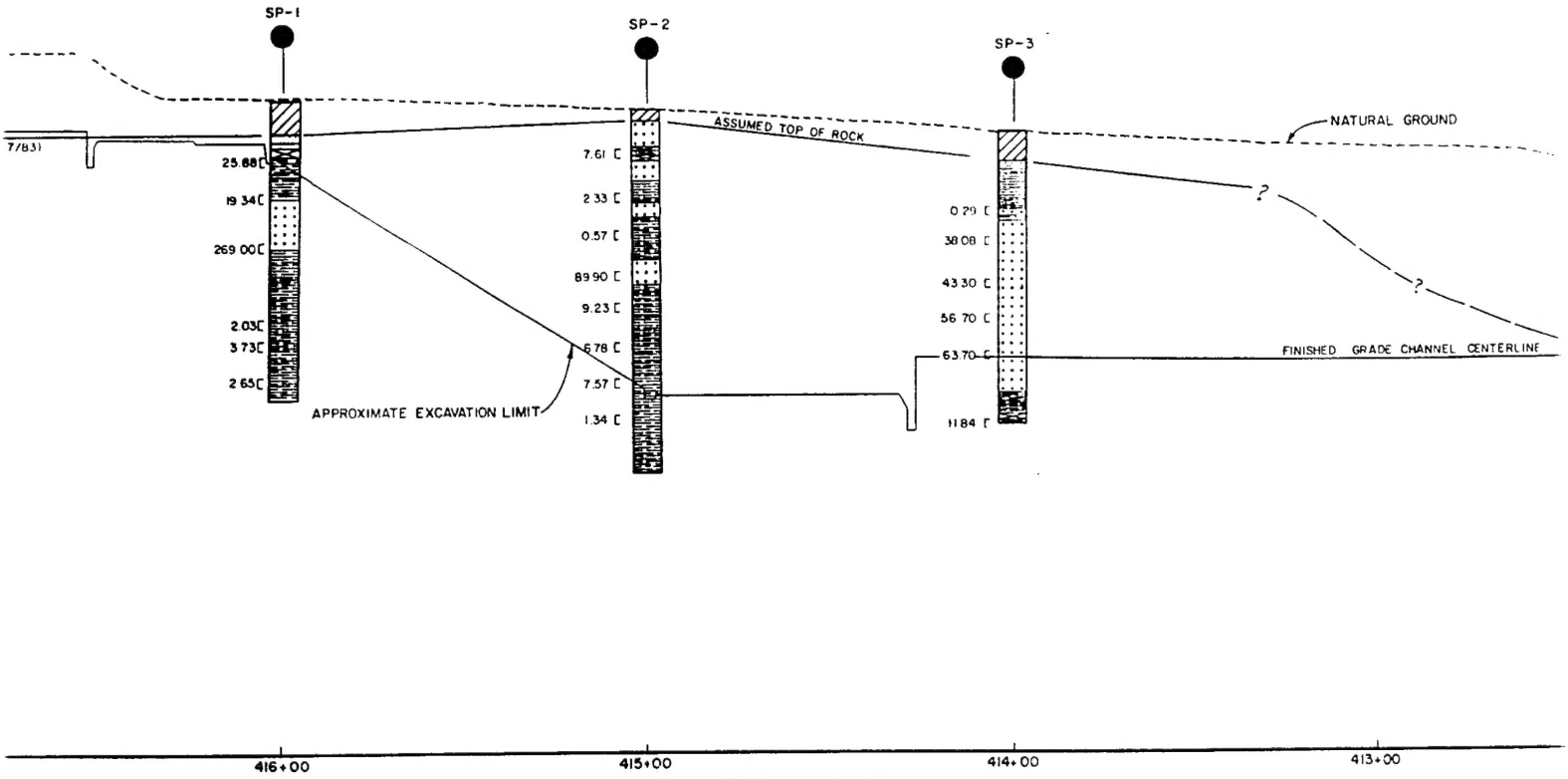


G F E D C B A

1 2 3 4

(1)

℄
NEW
EMBANKMENT



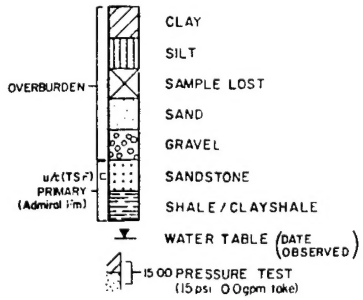
SPILLWAY STATIONS IN FEET

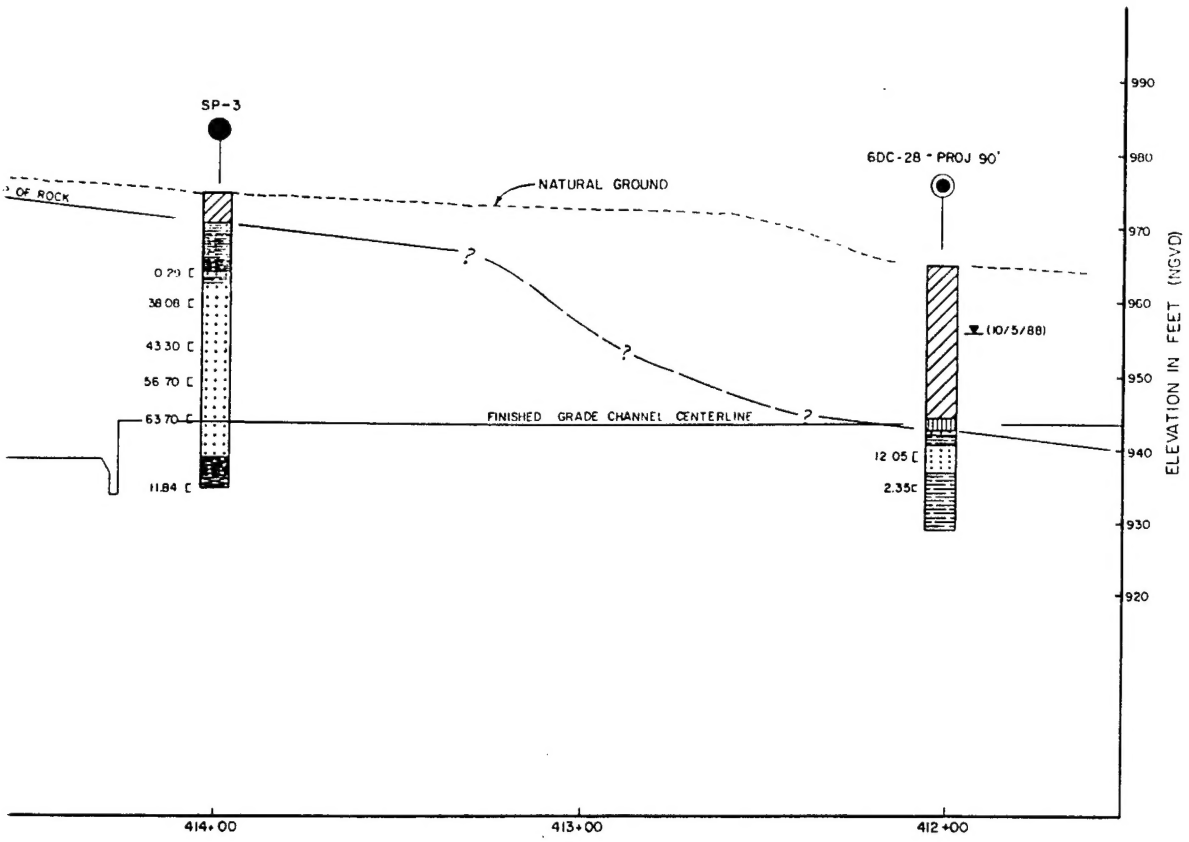
SPILLWAY PROFILE

SECTION B-B

LEGEND

- AUGER HOLE
- CORE HOLE
- CORE AND DENISON BARREL HOLE
- DENISON BARREL HOLE





THIS DRAWING WAS PREPARED FOR USE AS A CONTRACT DRAWING AND WAS REPRODUCED FOR USE IN THIS REPORT

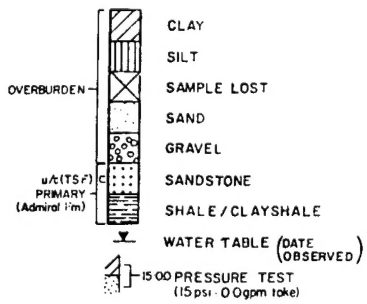
LEGEND

AUGER HOLE

CORE HOLE

CORE AND DENISON BARREL HOLE

DENISON BARREL HOLE



U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		U.S. ARMY ENGINEER DISTRICT, FORT WORTH CORPS OF ENGINEERS FORT WORTH, TEXAS	
DESIGNED BY: A. MARR	RED RIVER WATERSHED LAKE WICHITA HOLLIDAY CREEK, WICHITA FALLS, TEXAS LOCAL FLOOD PROTECTION PHASE III		
DRAWN BY: C. KIRBY			
REVIEWED BY: R. BEHM	SPILLWAY CENTERLINE PROFILE		
SUBMITTED BY: ROBERT C. BEHM	SOL. NO. DACW56-92-B-0032	DATED	
	CONTR. NO. DACW56-		SEQUENCE NO.
	DRAWING NUMBER BE 360-C3-98/3	SHEET NO. OF	

PLATE 10